NCST PANEL ON FUTUROLOGY

BACKGROUND PAPER
AND
SPECIAL NOTES FOR DISCUSSION

[Volume II]

DEPARTMENT OF SCIENCE & TECHNOLOGY

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PREFACE

The formation of the National Committee on Science & Technology (NCST) Panel on Futurology in mid 1973 has been the starting point of futuristic studies in India. The Panel identified nine areas, namely (i) Energy; (ii) Housing; (iii) Transportation; (iv) Communication; (v) Urbanology and Slum Problems; (vi) Rural Development; (vii) Food; (viii) Management; and (ix) Education, for study with a view to prepare scenarios for the year 2000 A.D. presenting likely and desired future perspectives and available options in these fields. It is hoped that these studies will afford the decision makers with a list of future course/s of action.

These nine Technical Sub-Groups include many scientists, technologists, economists, social scientists, and planners. The various sub-groups have so far gone through two sessions of discussion each. In terms of intensive analysis, a vast range of ideas of technological and social options have been considered in order to build futuristic scenarios as part of the nine interim reports from the various Groups which shall later on be integrated as Futurology Panel's report.

It is to be borne in mind that future research is largely inter-disciplinary in character. In a way it is both empirical and normative and is concerned largely with developing and applying systematic techniques for obtaining and making judgements on the nature and desirability of alternative futures. It has been rightly pointed out that the key aim of future studies, "is to broaden our time horizons and enable us not only to anticipate long-term change *per se*, but also to see how, by controlling such changes, we can increase the range of our alternatives and select alternatives likely to produce a better society in both the near and longer time periods". This establishes the need to have an integrated scenario.

Whereas the NCST Panel on Futurology has identified nine areas, nevertheless, an overwhelming need has been recognised to integrate the sectoral views and sub-group thought processes and alternatives. The overwhelming importance of creating an inter-sectoral understanding of India's problems thus has been the dominant theme in the deliberations of the various Sub-Groups. This has also necessitated a thorough familiarity with the background literature used by the different Technical Sub-Groups. In response to this need, this collection of Background Papers and Special Notes for Discussion, is now being presented to members. We are indeed thankful to the various members who have cared to prepare a variety of papers in different areas in order to stimulate sufficient thought.

The scope and range of these papers does not conform to a single methodology. Some of these papers make an adequate attempt to anticipate, predict and study the future possibilities in their respective sectors or specialisations. Most of these papers, by and large, hold a position wherein they conform to the view held by futurologist like Herman Kahn and his colleagues in that: "Any look at the future must begin with the present, or at least begin with that immediate past which, for all practical purposes, is identical with the present." They further argue that the future should be studied from the base-point of "where we are", which is a means to establish "where we are going". Stated in a simpler way:" the past leads to the present and the present leads to the future". This can be termed as the projective approach which has been adopted by members in some of the background papers of this collection.

There is yet another methodology which can be called a holistic approach. According to this approach, "having defined the problem at the present, it is necessary to leap backwards to examine the problem's component parts, i.e., those past influences, events, theories, and those lines of reasoning which may or may not have been instrumenta in determining the present course". The holistic approach thus examines the correct orientation in the continuam which embraces the past, present and future. It calls for a study of the salient features of all exclusive "whole" including the, "discovery of inter-detail connections within the all encompassing totality". Some of the papers included here would give the appearance of having adopted the holistic approach.

Some other papers are, however, based on the results obtained through the use of the Delphi technique which is a method for "solicitation and aggregation of the forecasts of a group of experts on a particular issue". This technique has been used for obtaining an unbiased consensus on quantitative estimate of data in terms of values and options and possible alternatives. It is quite understandable that, in the Indian context, use of Delphi is a relatively new methodology. Thus the opinions expressed in such studies may not reflect the totality of the view-point that could possibly be obtained in a particular area. The critics certainly have held findings obtained through delphi methodology research as scientifically vague, over-stated and a collection of snap-judgement-opinions. Nevertheless it is a well accepted technic. Delphi-studies do focus attention directly on the issue, provide a framework within which individuals with diverse backgrounds or in remote locations can work together on the same problem and it produces precise documented records.

In some papers, members, practically in all the nine sectors of their concern, touched on the question of life style. It is basically a normative question. Here, one is concerned with basic questions, such as: what kind of society we want to build in the year 2000? What choices and alternatives shall respond to that? And, what type of life style are we looking for? And, according to whose perception? This leads to several divergent opinions. In the context of Futurology which is essentially a study of the inter-play of resource and demand the two sides to the Life-style question would be: Let there be plenty of what the people need? This will give to every member of our society an opportunity to enjoy the life style they prefer to choose and afford. The opposite view could be: since our resources suggest there may not be enough for all then, let the 'social' or the 'public' interest prevail over the 'individualistic' and 'private' interest. Apparently, this is an area which deserves more intensive study and scrutiny. This would essentially be the search for matching of people's aspirations (sociologist's findings) and the opinion leaders views (the planners' indication of what people can get within limited resources). It could also lead to the delineation of the normatives in our preferred future. Indian life, as most papers in this collection indicate does call for a certain degree of rationalisation and the boundaries of this new rationality still needs to be determined.

Finally, there are also some papers here which do not pretend to make any attempt to undertake a futuristic forecasting exercise. In the form of small outline - essays and discussion notes on relevant areas they intend merely to provoke discussion or to explain the validity or the irrelevance of a given system.

All in all, these background papers and special discussion notes, have served the sub-Groups well. They have generated excellent brains storming sessions yielding a series of options and thought. All this is bound to lend to the work of the Futurology Panel a certain quality of thought, offering a vast range of ideas and meaningful alternatives.

It is extremely important to clarify that these papers are primarily in the nature of reading material. They simply provide intellectual motivation for the members of the Group which should serve the key purpose, namely, of building inter-sectoral understanding, to enable the Futurology Panel later on to build an integrated scenario for India 2000 AD. This collection of papers, therefore, does not constitute any policy position. I hope members will find this second collection of the background literature useful. The third collection of background papers would be issued by the middle of 1976

New Delhi, the
1st January, 1976.

(Satish C. Seth)
Convenor
NCST Panel on Futurology

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ENERGY

FUTURE ENERGY SYSTEMS OF INDIA - A DELHPHI STUDY

ABSTRACT:

The likely dates of occurence and the potential impacts of ninety six events were assessed using a Delphi study on the future energy systems in India. The respondents indicate that fast growth in nuclear power systems, installing super thermal power stations, establishing 300,000 community biogas plants, reducing national transmission losses and completion of ganga-cauvery canal are some of the events which will have maximum impact or they are the most desirable events. Certain policy imperatives derived from this study have been listed. A comparison of the predicted dates of occurrences of certain events by different Delphi studies has been made. Five possible scenarios are derived for the Energy sector.

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INTRODUCTION:

In this paper results of a Delphi study conducted in India, to forecast the energy systems that are likely to be developed at different times in the future and their relative impacts are reported. Technological forecasts derived through a combination of Delphi and other forecasting techniques could help the planners in India in more efficient allocation of resources and selection of projects.(1) This could leaddto the arrival of imperative technologies at earlier dates, than would otherwise be possible.

Delhi is a programmed sequential questionnaire approach probing the minds of people who are experts in a given area. (2-15) Until now most of the Delphi studies have been done in other countries and they are not likely to be directly applicable to developing countries like India. The technologies that are likely to be commercialised in India are dependent on the needs and resources of India, the R&D efforts within India in that area and the likely transfer of the specific technologies from abroad. This Delphi was conducted in Indian environment and the views of India experts were solicited. The technologies that are likely to be commercialised will depend to a large extent on the view points and directions of work of the some of these experts in India. Therefore a systematic probing of their minds through a Delphi was considered as a suitable first step in developing technology forecasts for India.

By B. Bowonder and P.K. Rohatgi, Department of Industrial Management, Indian Institute of Science, Bangalore -560012, India.

Current Status of Energy Systems in India:

The relative consumption of commercial fuels has been increasing; in 1953-54 they accounted for 33 percent of the total fuel sector whereas in 1970-71 this figure rose to 52 percent (16-21). The commercial fueld like coal, and electricity are substituting non-commercial fuels like firewood dung and vegetable wastes. Non commercial fuels are still being used but their growth rate in quantity terms has been very marginal, except probably that of firewood. The major lacuna in this sector is the lack of a plan for non-commercial energy nsector. Planned substitution and resource conservation can be the major policy imperatives for this sector. Burning Dung and vegetable wastes is a very inefficient way of fuel utilisation.(22-25) These can be fermented and used for making biogas which is comparatively non-polluting, and conserves the nitrogen which can be used as a fertilizer.

Of the commercial fuels, coal is the major indigenous resource of India. Most of our coal reserves are in the eastern sector of the country Indian coal is comparatively high in ash content (30-40%). Our reserves of good grade coal are around 100 billion tonnes and of this only about 2 billion tonnes is coking coal. Though the non-coking coal reserves will last for more than 200 years at a growth rate of 5%, the coking coal will last only for about 50 years. Coal production had stagnated around 80 million tonnes per annum for the last four years but is on the increase in 1975. De and for coal is on the increase because of the following reasons has fallen considerably in recent years in India. But the gestation periods for nuclear power generating systems in India is on the high side compared to other countries.

Transportation is a highly energy dependent sector. Transportation in India consists mainly of aeroplanes, trains, trucks, bullock-carts, boats and humans. Trucks and buses are more energy consuming compared to railways for unit tonne kilometer (29-34). Presently transportation trucks is increasing and t is is an undesirable trend. Basically aeroplanes, cars and trucks are highly energy intensive modes of transport and should be substituted by trains, bicycles and bullock carts. At present the major share of the petrol is consumed for personal transportation Unless efficient mass transit systems and public transportation systems are developed., the highly energy intensive mode of transportation, cars, are likely to increase. In major cities there is a lack of buses, their improper scheduling, their improper maintenance, and inefficient management systems. Efficiency of transportation undertakings is often related to managerial effectiveness. Bullock-carts are less energy intensive, however, the present design is highly inefficient and their load carrying capacity can be raised by 4 to 5 times of the

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present capacity. The bullock-carts have a greater effect on the rural life and rural transportation. The investment in bullock-carts is second only to that of the railways in India and their main fuel is the renewable fuel for the bullocks. It is very undesirable to substitute them by petroleum consuming vehicles (presently 12 million bullock-carts are in service) in view of the increased crude prices.

METHODOLOGY:

In the present study a modified Delphi similar to SEER (SYSTEM FOR EVENT EVALUATION AND REVIEW) was used as a basis for derving a list of forecasts. The events that were given in the Delphi were derived mainly from the following three sources (i) The possible events that are reported in futuristic studies conducted in other countries (36-127) and were relevant to India, (ii) Judgements of the authors of this study on energy technology in India, (iii) events suggested by the panelists in the first round which were included in the second round of the sequential questionnaire study.

A questionnaire containing development in the following general areas were prepared:

(i) efforts are being made to substitute fuel oil by coal in industries (ii) low temperature carbonisation plants are beingset-up in four different areas (iii) three coal based fertilizer plants are being commissioned, (iv) more thermal power stationsare being set-up, in addition four super thermal power stations of 1000 MW capacity are planned, and (v) steel production is increasing mainly based on blast furnace route.

The production of crude oil in India is only about 30% of the total crude throughout. The remaining is imported. The off-shore drilling programme has barely started yielding results. Since the price of crude has increased three times, the import bill for petroleum exceeds Rs.10,000 million per annum. Middle distillates (kerosene and diesel) are being consumed in larger quantities (in 1960 = 45%, 1973 = 20%). The middle distillate, demand which amounts to about 50% of the demand for the petroleum products, can be met easily by hydrocracking the residual fuel stock.(26) Presently the latter is used as fuel oil, refinery boiler fuel and furnace oil, where coal can substitute them. Though hydrocracking is costly it is very economical when the shadow prices of foreign exchange for impoting middle distillates are taken into consideration.

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Electricity i s assuming greater importance in the energy sector. Electricity generated per KW year of installed thermal power generation capacity is very low, about 3620 KWH per KW year. This average is around 5000 in other countries. In addition, the electricity distribution losses in India are about 18% and this is far greater compared to that in other countries.(25) In efficient management of power generating systems is therefore one of the basic reasons for the present crisis. The trend of electricity consumption is very telling. The consumption in the domestic light and small power sector is decreasing (1951=12.4%, 1970=8.5% of the total electricity consumption), and the consumption for agricultural pumping and irrigation has been rapidly increasing due to the green revolution (1951=4.3%, 1970=9,2%), so also the share of industrial power (28) (1951=63.7%, 1970=6 In many states electric power generation is dependent entirely on hydropower and this has caused many problems. Though hydropower is cheap it can be used only for reasonal and peak power loads because of the erratic nature of monso Nuclear power generating capacity is not increasing as plan earlier, even though the capital cost of nuclear power plan

(i) Petroleum products, coal and hydroelectrics (Table.2

(ii) Nuclear energy (Table-3)

(iii) Inconventional energy Sources (Table-4)

(iv) Storage, distribution and utilisation of energy (Tabl

(v) Transportation (Table-6)

The questionnaire was mailed to 288 scientists, governm officials, professors, industrialists, technologists and planners. The overall distribution of the panelists by their affiliations and their responses to questionnaires are given in Table-7. Any individual question in the first round was responded to by atleast 30 panelists. The participants were asked to anticipate the likely year of occurrence of the events listed by us; in addition they were asked to indicate the impacts in terms of major, minor and nil. The total impact of the event, if occurred was quantified by giving 10, 5 and 0 scores for major, minor an nil impacts respectively. The panelists were also asked to suggest event, other than those mentioned in the questionna which may have large impacts. In all 29 additional events were suggested by the panelists in the first round of the questionnaire.

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The responses from the first round of questionnaire were analysed and fed back to the panelists along with the second round of questionnaire. In the second round, the panelists were asked to review the group response given to them as the average of the answers of round one, and modify their previous response, if they so desired. They were also required to explicitly give reasons, if any, for being over optimistic or pessimistic compared to the group average. The results of the whole Delphi study is given in tables 2 to 6.

In addition to the expected date of occurrence of the event, interquartile range has been calculated and tabulated. The impact score of the group is given in terms of the average value (10 to 5.1 major, 5 to 1.1 minor, and 1 nil). The second round average response and the reasons for the divergence from the mediam response of the group are also given in tables 2 to 6. In the following discussions the median of the response from the second round of the questionnaire are used as the basis for discussion.

The confidence of the event is calculated by dividing the numbers of 'NEVER' by the total number of respondents. This does not represent the probability of that event occurring in the forecast year but represents whether the event is at all feasible to occur or not.

RESULTS AND DISCUSSIONS

A. Petroleum products, coal and hydroelectrics:

Increased production of coal, better management of power generating systems, increased off-shore drilling are some of the imperatives for India based on resources. According to the Delphi study the most desirable events in this area are (i) Indigenous production of first 20000 MW power generating plant by 1997. (ii) 30 million tonnes internal crude production by 1992 and (iii) coal production raised to 400 million tonnes per annum by 20001. The reasons for the slow growth of coal production are mainly organisational inadequacies. The long-term energy policy must not be based on the exhaustive use of coal since it is a non-renewable resource. Complete gasification of coal to substituted natural gas (SNG) is not needed for India since we lack the infra-structure for gas transport and distribution. Delay in increasing power generation capacity is related to lack of capital resources and managerial inputs. Sea-shore drilling operations are likely to yield oil upto 25% of our total demand by 1986. Some events suggested by the panelists include (i) low temperature carbonisation of coal (ii) energy from garbage (iii) oil from cellulosic wastes (iv) better management of power generation systems and (v) underground (double water head) power stations.

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B. Nuclear Energy:

Events involving Nuclear power generation have been identified as the events likely to have the greatest impact among all the events. Total nuclear power capacity reaching 25% of the total generating capacity by 2005, breeders using therium cyde by 1997, agro-industrial complexes based on fact is breeders by 2009 and desalination using nuclear power by 1999 are the events likely to have the maximum impact. According to the panelists these nuclear options were rated as the best for satisfying energy demand Ganga-Godavari linking by nuclear explosion, mining using nuclear explosions, laser indused fusion and fusion power generation were the other events suggested by the panelists. Nuclear energy is likely t be the cheapest energy before the end of the century.

C. Unconventional Energy Sources:

Unconventional energy generating modes are becoming more prominent and they are likely to be commercial in a large way by the 1990's. Installing 300,000 biogas plants by 1999, sola energy power stations by 20001, solar heating by 1993, solar pumps for agricultural uses by 1991 and biogas generators of 10,000 cu.ft. capacity using algae, water hycinths and cellul wastes by 1993 are the major events which will have maximum impact. Methanol fuel cells at homes and ocean thermal gradient power stations are two events which are not likely t occur in the near future. Wind mills for agricultural pumping is likely to be available widely before 1990 .

D. Storage, Distribution and Utilization of Energy:

Electricity is becoming the major commercial energy. Th events with maximum impact in this area are production of pow transmis sion losses to 5% by 2000, establishment of nationa power grid by 1995, and extra high voltage transmission by 19 Using sodium cables for power transmission and distribution electrical energy after converting it into hydrogen are even which are not likely to occur in the foreseable future. Supe conducting cables are likely to be in commercial use only in the next century. Integrated steel plants are likely to have own generating stations in 1990's and total energy systems w compulsory for all new industrial units by that time.

E. Transportation:

Transportation and energy sectors are linked closely th one can be viewed as a part of the other. Establishment of Ganga-Cauvery Canal by 20000-Never is the event which will have maximum impact, but the panelists feel that there is a chance that it will not materialize because of political rea 25% electrical locomotives by 1995 and 5 million commercial vehicles for road transport by 2000 are likely to be the oth major events of significant impact. Number of bullock carts are not likely to double because of the improvement in the efficiency of the present carts. Bullock-carts are likely to continue in service because of their service to rural econom Carts of load capacity of 5 tonnes are not likely to be in

Automobiles using coal as fuel and trains using rubber tires are not likely to be in use in the years to come because of the reasons given by the panelists. Unit train for transportation, hydrogen as onto fuel, sodium-sulphur battery car, improved bicycles, trains carrying 4500 tonnes of load, and double decker passenger trains are some of the other events of significance as suggested by panelists which were not listed in the first round of the questionnaire.

COMPARISON OF FORECAST DATES:

The forecasts made in the present Delphi exercise reflect the resource position, existing state of technology, man power availability, social attitudes and economic structure of India and the visions and plans of Indian scientists and technologists Delphi exercises performed in different countries yield different results depending on their respective environments. Table 7 gives a comparison of the dated of occurrence of similar events derived from Delphi exercises performed in other countries. From the results it can be seen that the new technologies are expected to arrive in India at considerably later dated compared to that in other countries. The results of the two Delphi studies (Present work and that by Sardana and co-workers) conducted with in (128) India agree fairly well. The study of Gordon and Ament (181) was conducted long back and it shows considerable difference with the other studies mainly because of the change in conditions, primarily the recent energy crisis and price hike. Use of solar energy, breeder and fusion are being given a boost with large R&D imputs in all developed countries.

Some comments of the panelists on the utility of the present study is given in Appendix-I. A list of panelists participated in both the rounds are included in Appendix-II.

SCENARIOS FOR THE YEAR 20000:

Four alternate scenarios based on the various combinations of most probable energy systems identified by the panelists of the Delphi have been presented in table-8. Evaluation of the different scenarios (a) to determine which of them is the best and (b) the development of detailed fine maps outlining research and production inputs required, will be dealt with in a subsequent paper by the authors.

POLICY IMPERATIVES FROM THE STUDY:

1. It is imperative for India to venture into nuclear energy in a big way

2. There should be a planned programme for non-commercial energy sector

3. Oil explloation programmes have to be intensified.

4. Railways should electrify and road transport should not be allowed to substitute railways

5. Wind pumps and solar pumps should be developed for agricultural pumping. Specific research funding has

6. Policy decision on looking at the possibility extra high voltage transmission should be taken.

7. Coal should substitute fuel oil in industry.

8. New petroleum refineries should be planned based on hydrocracking of residual fuel stock. The middle distillates thus produced can reduce the import requirements.

9. Future fertilizer units should be based on coal as the feed stock.

10. Urban sewage disposal and biogas production have to be effectively coupled.

11. Total energy systems have to be made mandatory in major consumer industries.

12. Proper management of power generation systems and transmission systems to be enforced especially to increase generating efficiency and to reduce transmission losses.

13. Energy policy should be increasingly based on renewable resources such as agricultural wastes, water hycinths, algae and animal wastes.

14. Energy demand should be curtailed by new attitude and value systems. Appropriate mmeasures to promote the adoption of these socially desirable systems will have to be taken.

15. Non-energy intensive industries are to be installed in preference to energy consuming industries.

16. Energy intensive personal amenities like cars, all electric homes, airplane travel to be reduced.

17. Design criteria for transportation vehicles should be fuel economy even if it implies higher initial costs.

18. Urbanisation should be curbed to reduce urban energy requirements.

19. Transportation and communication are partially substitutable. Since communication is non-energy intensive, it should be given preference wherever possible.

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A detailed study should be carried out on the cost-benefit effects of these policies together with futuristics to derive the long-term plans.

CONCLUSIONS:

(i) Results of a Delphi study on future energy systems in India are reported. The likely dates of occurrence of certain dates arrived through this Delphi study conducted in India, are later than the dates for the same events determined through Delphi studies performed in other countries.

(2) The eight events with the greatest impact (on a scale of 0 to 10) and their likely dates of occurrence, more than 50% probability, are the following:

Event	Impact	Likaely Year
(i) Nuclear power generation will reach 25% of the total generating capacity.	10.0	2005
(ii) Breeder reactors using throium cycle will be used for commercial power generation.	10.0	1997
(iii) Wide spread installation of agro-industrial complexes using fast breeders.	10.0	2009
(iv) Number of biogas plants in operation will become 200,000.	9.8	1999
(v) Nuclear desalination plants in India.	9.6	1999
(vi), India will indigenously produce its first 2000 MW power generating plant.	9.5	1997
(vii) Power transmission losses will be reduced to 5%	9.3	2000
(viii) Ganga-Cauvery Canal will start functioning.	9.3	Never

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(3) Three events not likely to occur by the year 2000, but have relatively larger impacts are as follows:-

	Events	Impact	Likaely Year
(i)	Electrical energy will be distributed as hydrogen over distances more than 600 KM.	8.9	Never
(ii)	Nuclear power plants will generate hydrogen which will be used as a primary fuel.	8.8	Never
(iii)	Power plants in oceans utilizing Ocean thermal gradient will be installed	7.3	Never

((4) Two events of relatively lower impact or desirability in India are:

	Event	Impact	Likely Year
(i)	First conventional MHD power generating unit in operation.	5.6	1992
(ii)	Automobiles will use powdered coal as fuel	5.0	Never

((5) Four alternate scenarios and some policy imperatives for India are also presented.

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TABLE 1 : RESPONSE TO DELPHI

Affiliation	Total mailed	Responded but did not participate	Round I Participated	Round II Participated
Government	59	6	9	6
Industries and Corporations	72	6	8	7
Educational Institutions	96	1	6	5
Individuals and others	9	-	2	1
Research Establishments	52	5	9	2
Total :	288	18	34	21
Percentage Response			12	62

TABLE 2 : PETROLEUM PRODUCTS, COAL AND HYDROELECTRICS

Event	Impact (10-0)	IQR Round I	IQR Round II	Probability of the event occurring	Year of Occurrence		Comments of Penalists:		
					Round I	Round II	Earlier Occurrence	Later Occurrence	Never
1	2	3	4	5	6	7	8	9	10
.1 Consumption of coal will be 400 million tonnes per annum (1868=0.5 MT, 1900=55.5 1970=80.0 1972=77.8)	8.6	2005-Never	2000-Never	0.56	2009	2001	Target for power in Vth Plan will be met. Strong effort on substitution by coal necessary to maintain minimum per capita energy input.	Consumption cannot exceed production. Techno-economic policy reasons. Technological constraints.	Our energy policies should not plan for such a large consumption of a non-renewable source. We should taper off the use of coal by 2000. Due to use of other sources not prone to pollution. Change in attitude of society.
.2 Consumption of coal will be 200 million tonnes per annum.	8.0	1985-1990	1985-1990	1.0	1990	1993	Target for power in V Plan will be met. Due to consumption from energy shortage.	Increase in coal production has been slower than expected.	

1	2	3	4	5	6	7	8	9	10
.3 5% of the coal production will be gasified.	6.6	1980-1990	1985-2000	1.0	1989	1991		Infrastructure for gas transport and distribution not available. Highly capital intensive. Calcutta, Bombay & Durgapur plants are not based on total gasification.	Not needed for India.
A.4 First coal liquification plant to produce oil will be operational.	7.6	1985-1990	1985-1990	1.0	1990	1989	Current R&D efforts will yield quicker results. 10 years is enough to finish pilot trials.	Possibleonly if radically economic systems design developed. Technology is complex & costly.	
.5 Total electricity demand will be 200 m. KW.	7.7	2000-2015	2000-2015	1.0	2004	2006		A slow rate of growth of electricity consumption.	
.6 Total installed electricity generation capacity will be 150 m. KW. (1950=2.3, 1956=3.42, 1961=5.65,1966=11.0, 1971=15.0,1974=23.1)	8.1	1989-2002	1990-2005	0.92	1999	1998		Raw material problems. Lack of proper management inputs.	
.7 Consumption of petroleum products in India will reach 50 million tonnes per annum. (1950=3.32 MT, 1955=4.81;1960=7.78; 1966=12.96,1970=18.73,	8.2	1985-1995	1985-1992	0.94	1987	1992		Restricted use due to high price, we may start exploiting them for foreign exchange curing their internal use.	There won't be enough indigenous supply and no resources to import oil.

1 :	2 :	3:	4:	5:	6:	7:	8:	9:	10
A.8 Internal crude production will reach 30 million tonnes/annum. (Presently about 7.7 million tonnes).	9.1	1985- 1995	1985- 1990	1.0	1992	1992	Bombay High & intensification of oil exploration programmes. ONGC plans for 30 are in the 80's.	1992 is too optimistic. Present reserves& infrastructure does not justify this (discovery of totally new reserves ignored). Fraction of indigenous crude is low.	Nuclear energy utilization will delay this for ever.
A.9 Hydroelectric power generation capacity will be 25% of the total generating capacity. (1939=41.3%, 1951=31.3,1961=33.9, 1970=39.5).	5.8	1985- 2000	1987- 2000	1.0	1992	1993	Acute power shortage will compel quicker development. Monsoon is unreliable, climatic conditions are showing erratic variation. Cannot depend on monsoon.		We may depend more on hydroelectric and % will not come down.
A.10 India will indegenously produce its first 2000 MW power generating plant.	9.5	1990- 2010	1987- 2000	1.0	1996	1997	Priority given to this concept.	Single 2000 MW unit may take time for development. Supporting industries and infrastructure not available.	
A.11 Production of naptha will be 10 million tonnes per annum (1970=0.83 MT, 1971=1.18 MT.)	7.6	1990- 2010	1990- 2000	0.73	2002	1997	Growth rate in future will be higher than present one. Bombay High success.	This requires a crude through put of 60 mT which may not be achieved before 2002.	Future fertilizer plants will be based on fuel oil or coal. Crude for so much naptha will not be available.
A.12 Liquified petroleum gas production will reach 5 million tonnes/annum. (1970=0.166 MT, 1971=0.27 MT).	7.1	1985- 2000	1990- 2000	0.71	2001	1997	Anti foresation drive. Urbanisation.		Crude for so much LPG will not be available.

1	2	3	4	5	6	7	8	9	10
A.13 Utilization of all practically feasible hydroelectric sites will be achieved (1973 = 6.786 MKW)	7.1	1990-2000	2000	0.86	2000	1999		Large gestation period for construction. Techno-economic forces. Depends on the relative importance given to hydro development.	Cannot depend very much on monsoon.
A.14 First underground nuclear explosions for petroleum exploration.	8.3	1985-2000	1985-1990	0.90	1989	1991	Current thinking will advance the event. Experimental explosion for oil in 1980.		
A.15 Sea-shore drilling operations will yield 25% of total oil production in India.	8.5	1985-2010	1985-1990	1.0	1986	1986	Bombay high may yield 5 million tonnes per year by 1980.		
A.16 Any other development or event which will have significant impact on the energy scene of India.									
A. Piped coal gas			1990	1.00	1990	1990	To a limited extent in Calcutta&Bombay.	Not enough R&D and other inputs.	Nuclear energy will make others obsolete.
B. Low temperature carbonisation.			1990	1.00	1990	1987	Decisions to go ahead, Designs are being completed.	No serious effort to commercialise.	
C. Large Scale Gobar Gas Plants.			1985	0.83	1981	1984		Lack of planning & organisation.	Unlikely to be of any significance. The reaction rates are to be increased. (Residence time should be decreased from 30 days to 3 days.) Raw material collection is a problem.
D. Energy from Garbage			1985-1990	1.0	1985	1988	N	No R&D labs for this.	
E. Oil from cellulosic wastes			1995-2000	1.0	1995	2000		Lack of backing.	

TABLE 3 : NUCLEAR ENERGY IN INDIA

Event (If you feel the event will never occure, please write 'Never'. 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
B.1 Nuclear power generation will reach 25% of total generating capacity (present=about 4%)	10.0	1990-2008	2000-2008	0.8667	1998	2005	Nuclear energy will be the cheapest energy by 1990. Superiority of atomic power.	Slower rate of growth of atomic minerals consumption and breeders. Atomic Energy Commission plans are for this. Problems in implementation and in infrastructure development supporting industries are lacking.	
B.2 Installed nuclear power generation will be 10 million KW (1974=0.98MKW; 1970=0.190 MW).	8.3	1990	1995	0.9333	1996	1998			
B.3 Power generation using fast breeder reactor will be achieved in India.	8.9	1985-1990	1985-2990	1.000	1988	1989	First prototype breeder will be ready at Kalpakkam by 1980.	Test reactor will be ready only by 1980. Full scale plant will take 10 more years.	
B.4 Breeders using thorium cycle will be used for commercial power generation.	10.0	1990-2000	1995-2000	1.000	1993	1997		Thorium technology needs lot of development work. Gestation period is long for thorium cycle.	
B.5 Wide spread installation of agro-industrial complexes using fast breeder reactors.	10.0	2000-Never	2000-Never	0.6000	2006	2009	The pressure from need factor will be such that we will achieve this earlier.	Such complexes are very high capital intensive.	Highly energy intensive.

TABLE 3 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
8.6 Desalination plants using nuclear energy will be operational India.	9.6	1993-Never	1999-Never	0.6667	1995	1999	First experimental plant in 1990.	Only in some coastal locations, it may be economical.	Not a high priority item in plan. Soler energy is to be preferred for this.
8.7 Nuclear power plants will generate hydrogen to be used as primary energy.	8.8	2000-Never	Never	0.4167	2002 Never	Never		Generation of hydrogen from nuclear power plants may be achievedmuch earlier. But use of hydrogen as primary energy requires several changes in storage, transport systems and consumer habits.	Inconceivable now. Not needed in India.
8.8 First 1000MW nuclear power generation plant will be installed (single 1000MW unit).	8.1	1995-2010	1993-2000	1.000	1995	1996	Sensible heat from reactors can be used as process heat in industries.		
8.9 Any other development or event in the area of nuclear energy utilization or application, which will have large impact in India.									

TABLE3 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
A. Nuclear explosion for linking Ganga-Godavari.			2000			2000	Contour canals at various elevations for better water management by linking rivers.		
B. Nuclear-energy for Mining.			1990		1980	1990	Nuclear energy for mining & construction is feasible by nuclear energy because of recent Indian experiment.		
C. Nuclear energy will be cheapest energy.			2000		1990	2000			
D. Laser induced fusion			2000		2000	2000	This will be achieved early because of intensive R&D.		
E. Nuclear fusion Power generation			2020		2020	2020			

TABLE-4: UNCONVENTIONAL ENERGY SOURCES

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
C.1 Solar energy will be used for heating purposes widely.	8.6	1990-2005	1990-2000	0.9333	1992	1993	Urge for cleaner environment. Intensive R&D efforts as planned by NCST. Already many prototypes in market.	May become commercial but not very significant in terms of energy consumption.	
C.2 Solar pumps will be available commercially for agricultural uses.	7.9	1990-2000	1990-2000	0.9333	1992	1991	Intensive R&D plans.		
C.3 Solar air-conditioners will be available for commercial fish and fruit preservation.	7.0	1990-2005	1990-2000	1.000	1994	1997	Intensive R&D plans		
C.4 Wind mills will be used for irrigation (5000 litres/day)	7.0	1985-2000	1985-1990	0.9167	1987	1989		Only in coastal areas.	
C.5 100000 cft biogas generators (using algae, water hycinths and cellulosic wastes) will be functional.	8.2	1987-2000	1989-2000	0.9091	1992	1993	Biogas programme has lately received unprecedental attention.	Combined net work not possible before 90's.	
C.6 Sewage, dung and wastes of urban will be combined, and methane generated to be used	7.9	1985-1995	1985-1990	0.9412	1989	1990	Both sewage disposal and energy production in one step. Should be given high priority.	Needs large research efforts by a full fledged agency. Technological constraints for combination exists. Methane generated can be used as cooking as if supplied through pipeline	Community plants are brought with large number of problems.

TABLE 4 (Contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
C.7 Number of gobar gas plants in (5000 cu. ft. average capacity) operation will be about 3 lakhs (one per village of population less than 500).	9.8	1990-2003	1990-2000	0.8571	1995	1999	Government already offering several incentives.	Khadi&Village Industries Commission is not the proper organisation for promoting this.	The need may not be there for such large numbers.
C.8 First commercial methanol plant using coal.	7.0	1990-1995	1986-1995	0.8889	1995	1990	Significant effect in reducing our dependence on imported crude.	Commercial experimentation of the process developed may gross the first quarter of 21st century.	
C.9 Methanol will be used as automobile fuel.	6.9	1990-2010	1990 2000	0.6000	1992	1991		Wideusage requires installation of large number of plants.	
C.10 Fuel cells working on biogas (gobar gas) will be manufactured commercially in India.	7.7	1990-2005	2000 2025	0.7778	1998	2005		Technological organisational & Policy constraints. No work to increase output efficiency and to reduce weight and size.	
C.11 Fuel cells with methanol as fuel will be used for electric utilities in urban homes.	6.7	2000-Never	2000-Never	0.4545	2002 Never	Never	Reduce load on generating stations.	Not likely in urban homes.	
C.12 Power plants in oceans utilising ocean thermal gradient will be installed.	7.3	2000-Never	Never	0.3846	Never	Never	Enormous potential. Intensified R&D by developed country.		

TABLE-4 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
C.13 Solar cookers will be used in India for cooking purposes in urban homes.	6.8	1990-2005	1985-2000	0.833	1991	1992	Feasible in tropical countries like ours even now. Israel has already done this.	Development of solar energy equipments has yet to start commercially. This may not be possible in urban homes due to congestion. Only solar to electricity conversion needed.	
C.14 First conventional MHD power generation unit will be in operation.	5.6	1990-2000	1990-2000	0.9000	1997	1992	USSR-India collaboration in this area.		
C.15 First MHD power plant of 500 MW capacity will start functioning (Nitrogen fertilizer bye-product).	7.7	1990-2010	1996-2005	1.0000	2005	2002		Large number of technological and material problems.	
C.16 Solar energy power stations will be installed.	8.5	2000-Never	2000-2020	0.6923	2000	2001		Problem of solar energy collection. Large scale solar energy conversion requires economic direct conversion devices and batteries. Technological & organisational problems for building big scale power station. Efficient storage devices needed.	Not a tangible idea.
C.17 Solar energy will be used for metallurgical melting and refining.	7.2	1997-Never	1996-2020	0.6154	1997-Never	2014			For metal refining possible not for petroleu refining.

TABLE-4 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
C.18 Any other development or event or new unconventional energy source which will have impact in India.									
A. 15 MKW solar power plants.			1995-2000		1993	1997			
B. Geothermal power plants.			1990-2000		1995	1998	Very low capital intensive.		
C. 1 lakh gobar gas plants.			1985-2000		1980	1993			
D. Tidal power plants			1990-2000		1990	2000		Very inefficient source.	

TABLE 5 : STORAGE, DISTRIBUTION AND UTILIZATION OF ENERGY

1.	2.	3.	4.	5.	6.	7.	8.	9.	10
D.1 Electrical energy will be distributed as hydrogen over distances more than 600 KM.	8.9	2000-Never	Never	0.3000	2000-Never	Never	Pressure for prevention of pollution will accelerate this.	Technological and policy problems for achieving this on large scale.	
D.2 Sodium cables covered with PVC will be used for electric power distribution.	6.9	2000-Never	Never	0.3000	Never	Never			
D.3 Total energy systems will be compulsory for new industrial units.	8.3	1990-2000	1990-2000	0.7857	1996	1995		Requires large R&D efforts.	
D.4 Integrated steel plants will be self-sufficient in power generation, using total energy systems.	8.1	1990-2000	1995-2000	1.000	1997	1996		Requires large R&D efforts.	
D.5 In 50% of the existing establishments low pressure steam generation plants will be substituted by back pressure or pack-out turbine generating power.	7.3	1990-2000	1990-2000	0.7500	1992	1995			Need may not arise
D.6 Superconducting cables will be used for long distance power transmission.	8.5	2000-2011	2000-2005	0.7500	2003	2005		Now, superconduction is possible only at cryogenic temperature.	Very larg scale dis bution nc needed in India.

TABLE 5 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
D.7 Extra high voltage transmission for very long distances (at least 1100 KV and 1000 KM).	8.6	1990-2000	1990-2000	0.9286	1995	1994	If super power stations are to be installed at pit heads this is necessary. Already planned & will not take more than 10 years.		
D.8 Power transmission losses will be reduced to 5% (present national average 18%).	9.3	1990-Never	1990-2000	0.7857	1996	2000	If extra high voltage transmission becomes widespread.	Reaching that efficiency is doubtful. Technically very unlikely.	Very long distance transmission not needed.
D.9 Microwave power transmission will be used for distance upto 1000 KM.	8.1	2000-Never	2000-Never	0.6364	2000	2003	Transmission towers change the ecology and maintenance is a problem.		
D.10 National power grid will be established.	8.9	1990-2000	1990-2000	0.8824	1991	1995	Essential for redistribution amongst surplus/deficient states.	Under present political set-up integrated approaches are difficult. Socio-political reasons.	
D.11 Regional power-grids will become functional.	8.3	1985-2000	1985-1990	1.000	1986	1986	State grids are operative & regional grids will not take long.		
D.12 Coal based thermal power plants will utilise gas turbines at least in 50% of the total plants.	8.0	1990-2000	1990-2000	0.8333	1998	1997	Super thermal power stations at pit head is planned in 1980's Gas turbines are better in terms of fuel economy & efficiency.	Our coal contains less voltile materials per tonne and conversion to gas may take long time for large scale utilization.	

TABLE-5 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
D.13 Any other development or event which will have large impact in the area of storage distribution and utilization of energy.									
A. Supercooled conductors for distribution.			2000	0.6667	2000	2000			
B. Central Electricity Authority will be established.			2000		1990	2000		Already revived but ineffective.	
C. Hydel pumpled storage system.			1985-2000		1984	1992	They are being implemented from now.		
D. Underground Hydel power stations with double the present Heads.							Russians are installing one plant.		

TABLE-6: TRANSPORTATION

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
E.1 Electric automobiles will be 5% of total automobiles.	6.7	1990-2003	1995-2000	0.8125	2993	2000	Very optimistic about development of new technologies. Solar batteries may advance this.	Needs large R&D inputs. Technological constraints. Even in advanced countries it has not become commercial.	
E.2 Trains will be using rubber tyres.	5.9	Never	Never	0.3571	Never	Never	May be for new urban underground systes.	Deflation of rubber tyres cause problems.	Railways does not have any Rubber tyres though less noisy but very unsatisfactory from safety reasons. Steel wheels has to be incorporated as stand by.
E.3 The percentage of steam locomotives will be 50(1951=98.9%, 1956=98.4, 1966=90.4, 1971=84.1, 1973=81.0)	7.9	1990-2000	1997-2010	0.9375	1997	1998		The percentage cannot reduce so drastically since electrification is slow. Railway plan envisages this in 2000.	
E.4 Electric locomotives will be 25% of total (1951=0.88%, 1961=1.23, 1966=3.43, 1973=6.07).	8.5	1990-2002	1995-2000	1.000	1997	1995	New rail lines are not planned so only conversions. Preferably due to energy constraints. Electric traction preferable to diesel traction.	Current financial stringency has caused a delay in electrification railway plans for this around 2000.	

TABLE-6 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
E.5 Commercial vehicles (trucks & buses) production will be 200000/year (1972= 38000/annum).	8.5	1990-2001	1995-2000	0.8750	1996	1995		Increasing rate of road accidents.	
E.6 Total number of two commercial vehicles in India will be 5 million (19 =0.24M, 1971=0.45 M).	7.3	1990-2010	2000-2004	0.9286	2002	2000	Due to pressure from railways.	Increasing rate of road accidents. Energy intensive compared to railways.	
E.7 Pipelines will be used for coal transportation for distance upto 500 KM.	7.9	1990-2010	1995-Never	0.6364	1995	1995	Technology available abroad, can import technology.	We have yet to go a long way to achieve this in large scale.	
E.8 Superfast trains connecting Delhi and States capitals will run at 200 KPH.	6.9	1990-2000	1995-2000	0.8571	1997	1995			High speed is only a luxury. Railways consider that these are costly for development & operation. Energy crisis inhibits these highly energy intensive propositions. Railways present policy is against this concept. 95% of our railways are patronized by
E.9 Huge trucks using gas turbines (100 HP) will be manufactured in India for commercial purposes.	7.1	1995	1998	0.8182	2000	1998			

Table-6 (contd.)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
E.10	Air-cushion vehicles will be used for coastal passenger service and survilience.	6.7	1990-2000	1990-1995	0.9167	1993	1995	Vehicles available abroad for sale.		
E.11	Ganga-Cauvery Canal will start functioning.	9.3	2010-Never	2000 Never	0.5000	2010	2000 Never		Political problems.	A non-feasible idea under the present political set-up. Geography is against it can cause health disausters due to spread of diseases.
E.12	Bullock carts capable of carrying 5 tonnes will be in use (2 wheeled).	5.9	Never	Never	0.4167	Never	Never	Large size bullock carts will be used by 1990.		
E.13	Number of bullock carts in India will reach 25 million (presently 12 million)	6.3	Never	Never	0.3846	Never	Never	Rural economy and poverty likely to continue. Bullock cart will be the major rural transport linked with cattle-agriculture symbiosis.	This doubling may not occur since capacity increases per cart.	
E-14	Automobiles will use powderadcoal as fuel.	5.0	Never	Never	0.400	Never	Never	Solvent extration gives ashless coal and this can be used as auto fuel. Technology is being commercialized.		Coal is a messy fuel for automobiles. It will not stage a come-back.This is one place where use of coal is extremely doubtful.

Table-6 (contd.)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
E.15 Automobiles will use petrol-alcohol mixture as fuel.	5.9	1985-1990	1988-1990	0.0633	1969	1988	Pressure for cleaner environment.	Problems of using mixed fuels & mixed combustion.	
E.16 Any other development or event which will have large impact in the area of transportation for India.									
A. 7 H2 as automobile fuel.			2000		2000	2000			
B. Unit train for coal transport.			1990		1990	1990			
C. Underground electric trains for 4 major cities.			2000		2000	2000			
D. Sodium sulphuricles. Battery Car.									
E. Sodium sulphuricles. Battery Car.									
F. Improved bicycles.			1990		1990	1990			
G. Bicycle ownership in urban areas 1 in 3			1990		1990	1990			
H. Scooter and Motor cycle production 1 million/annum			1990-1995		1990	1993			
I. First unit transport train			1990		1985	1990			
J. 4500 tonne trains			1985		1985	1987			
K. Double decker passenger trains			1985-1996		1985	1996		Mainly safety considerations.	

Table-7 : COMPARISON OF ENERGY DELPHI STUDIES

Event	Present Study (India)	Sardana (129) et al (India)	Manitoba (130) group (Canada)	Japan (131) group (Japan)	Bright (14) (USA)	Gordon & (132) Ament (USA)
1	2	3	4	5	6	7
MHD	1992	1990	1988		1988	
Solar Energy Power Station.	2001	2000	After 2000	2000 (2 million KW Plant) 1985 (10000KW)	1990	Later
Tidal power	2000	2000	2000			
Geothermal power plant	1998			1985 (50000KW using volcanic steam)		
Fast Breeder	1997 (using thorium cycle)	1985	1985		1985	
Coal Liquefaction.	1989		1982			
Peaceful nuclear explosion for gas & oil exploration.	1991		1980			
Super conducting cables	2005	2000	1985		2000	2012
Electric automobiles/mobiles.	2000				1983	

Table-7 (contd.).

1	2	3.	4.	5.	6.	7.
Nuclear Fusion Power generation.	2020		2000		2000	1985
Extra high voltage transmission.	1994		1985			
Microwave power transmission.	2003		1993			
Geothermal power	1998		2010			

TABLE-8 : ENERGY SCENARIOS

	Coal	Oil	Electricity	Transportation.	Biogas	Nuclear	Solar & Wind
1.	2.	3.	4.	5.	6.	7.	8.
Scenario-1	400 million tonnes	36 million	150 million KW installed capacity	Trucks 800,00 Buses 190,000 Cars 800,000 Trains and mass transit systems on highside.	300,00 units mostly in villages.	15 million KW generating capacity	1 MKW
Scenario-2	200 million tonnes.	60 million tonnes.	150 MKW installed capacity.	Trucks 1200,000 Busses 250,000 Cars 130,000 Trains and mass transit systems based on diesel on low side.	300,000 units mostly in villages.	15 MKW generating capacity.	1 MKW
Scenario-3	200 million tonnes.	36 million tonnes.	200 MKW installed capacity.	Trucks 800,000 Buses 190,000 Cars 800,000 Trains and mass transit systems based on electricity on high side.	300,000 units mostly in villages.	50MKW generating capacity.	1 MKW
Scenario-4	200 million tonnes.	36 million tonnes.	150 MKW installed capacity.	Trucks 800,000 Buses 190,000 Cars 800,000 Trains and mass transit systems on high side.	500,000 units in villages and urban centres coupled with sewage disposal. Tractors run on biogas.	15 MKW generating capacity.	5% of the total agricultural pumps using solar & wind pumps.
Scenario-5	200 million tonnes.	36 million tonnes.	200 MKW installed capacity.	Trucks 800,000 Buses 190,000 Cars 800,000 Trains and mass transit systems based on electricity.	500,000 in villages and in urban centres coupled with sewage disposal.	35 MKW generating capacity coupled with hydrogen economy.	15 MKW power by solar power generation. Wind pumps solar pumps.

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APPENDIX-I

Comments of panelists on the utility of this study

Since this was one of the first few Delphis conducted in India, it was decided to elicit the opinions of panelists (who participated in both the rounds) on the utility of this type of Delphi studies, specially in the Indian context. The following are some of the relevant comments quoted verbatim.

i) "I am not completely convinced about the utility of this type of technological forecasting. Many of the technical possibilities depend a great deal on resource allocation, policy decisions, existing power structure, institutional mechanism etc. I would imagine a brainstorming session might be equally valuable".

ii) "We believe that studies of this nature could certainly be useful for long term planning of national energy and transportation policies, especially if the impact of the forecast developments could be translated in terms of economic and social considerations".

iii) "There is no doubt that this type of Delphi exercises, if done on a basis of broad response, would certainly indicate to the future planners, the various options for attaining the objective so far as energy is considered".

iv) "The questionnairs as such is wide based and helps out to bring out the probability estimates on the subject from the view point of a wide range of persons/organisations engaged in various fields of activities and may serve as a general data for use in the process of national planning".

v) "Any such exercise can be extremely useful in formulating the broad strategies and the directions for research and developmental efforts on a national level. However, the planners involved in this process must be careful not to take the forecast timings of occurrence as sacrosanct. Finally, if such a technique is going to be used, it is necessary to constantly update the information in the light of new discoveries being made all the time all over the world".

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vi) "Regarding my general comments on the utility of this type of exercise, I have a feeling that it is indeed a valuable tool provided, the population to which the questionnaire is sent is large and composed as far as possible of people with some association at least in the concerned field".

vii) "I feel that the group answers received from the Delphi questionnairs should be useful in concerntrating on projects which most of the knowledgeable people think can be achieved during the next 15 or 20 years, and which will have a significant impact in the economy of the country".

viii) "The answers are conditional, as you have not given any socio-economic frame work, within which the technology is supposed to grow. Firstly, it is wrong to assume that the dynamics of scientific and technological growth can be divorced from the socio-economic environment, especially for long periods of time. So, any futurological forecast, based on the present state of society alone is bound to be futile. Secondly, when we speak of energy requirements, a subjective factor is brought in - whose requirement, has also its sociological importance; a small fraction of the society may like to have its energy consumption levels growing higher and higher with electric kitchens, a car for each family member, and so on. Can we call this the requirement of India? you have not specified whether the questionnaire is to be filled in on the basis of what is desirable from our point of view or on the basis that present trend will continue for the period under consideration. So to fill in the questionnaire, we have assumed that the present elite strata of the society which enjoys the power of deciding the requirements of the nation will continue to enjoy that power for two decades to come. The present trends in economic growth and planning are megalomaniac, imitative of the west in nature, and presupposes that the more it is, the merrier. We are of the opinion that this is not altogether correct. GND, per capita consumption etc., may reveal only certain aspects of economic properity, but definitely ignore the large islands of intense poverty and social malaise prevalent... Apart from the basic philosophy of forecasting in a futuristic approach, the bias of questions have a lot to do with the type of answers they evoke".

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(ix) "Comments from persons working or knowledgeable in the general area would be quite useful as indicators, but often lay opinions and wishful thinking are mixed with calculated and intelligent extrapolation".

(x) "Regarding the utility of this type of Delphi exercises, if the questionnaire is put in the hands of experts who know all the factors bearing on the problems, perhaps that may help in correctly assessing the position. This will naturally be an attempt to correctly forecast the events to come.

If however, this questionnaire is answered by persons who have only a general knowledge about national and international developments, the replies cannot be a guide for forecasting the future. But at the same time they will be useful to know what the general public feels about the future. This also is not of less importance. This may reveal the direction in which people expect things to happen. It may some time happen that the robust common sense of the man-in-the street proves to be more correct than the expert knowledge".

(xi) "I am of the view that this type of exercise would provide very useful information in forecasting different technical developments and their resultant impact on different areas of the economy".

APPENDIX-II

Panelists and their affiliations

Name	Organisations
1. Dr. R.K.Shrivastava	Indian Institute of Petroleum, Dehra Dun.
2. Mr. L.G.K. Murthy	Bhabha Atomic Research Centre, Bombay.
3. Prof. G. Ayyaswami	College of Engineering, Madras.
4. Mr. M.S. Seth	Engineering Projects Ltd., Delhi.
5. Dr. M.R. Srinivasan	Power Projects Engg. Division, Bombay.
6. Dr. H.N. Sethna	Department of Atomic Energy, Bombay.
7. V.V. Kothare	Tarapur Atomic Power Station, Tarapur.
8. R.S. Ganapathy	Department of Atomic Energy, Bombay.
9. K.S. Subramaniam	Madras Atomic Power Project, Madras.
10. Managing Director	Caltex India, Bombay.
11. Prof. S.Subba Rao	Indian Institute of Management, Bangalore.
12. Mr. D.K. Basu	Central Coal Washeries Organisation, Dhanbad.
13. Dr. A. Khosla	Deptt. of Science & Technology, New Delhi.
14. M.P. Kharkar	Air India, Bombay.
15. M.N. Kumta	Mahindra & Mahindra Ltd., Bombay.
16. Dr. T.K.Toy	Chemical & Metallurgical Design Co., NewDelhi.
17. Prof. E.S. Rajagopal	Indian Institute of Science, Bangalore.
18. Mr. V. Padmanabhan	Khadi & Village Industries Commission, New Delhi.
19. Prof. A.K. De	Indian Institute of Technology, Bombay.
20. Mr. R.N. Seth	Railway Board, NewDelhi.
21. Dr. M.G. Krishna	Central Fuel Research Institute, Dhanbad.

NEW ENERGY POLICY FOR INDIA*

It is clear that what is required is a drastic shift in the pattern of the energy base of the Indian economy on a permanent basis which, let us be clear, cannot be brought about without a corresponding shift in the technology of production and transport. In this direction, I would like to suggest the following measures.

(i) There should be a massive programme in every one of the Indian villages to plant trees to provide, after a few years, larger quantities of firewood and charcoal for all the villages, with requisite surplus for urban areas. This programme of afforestation has to be the kingpin of any strategy to meet our permanent oil crisis. If we fail in this programme, chaos will grip our domestic life and our industrial and economic life.

(ii) After augmenting supplies of firewood and charcoal as also inferior mineral coal for domestic consumption, every effort should be made to slow down, and if possible, even reverse, the on-going shift from wood, charcoal and soft coke to kerosene. This may sound retrograde, but given our situation, there is no escape from it. Take any other alternative, think through all its implications and it would be soon evident that the alternative is much less feasible than the step suggested here.

(iii) Wherever possible, we should encourage the establishment of gobar gas plants. This gas may be increasingly used as fuel not only for the kitchen but also for lighting and for running small diesel engines.

(iv) Discarding the traditional policy of laissez faire in technology, we must so re-orient the technology of our producting system as to reduce the consumption of all fuels in general and of mineral oil in particular.

(v) Wherever possible, we must not only stop commissioning of new oil engines but in fact go further and replace oil engines already in operation by other types of equipment. For example, I would suggest such a reversal on the railways.

(vi) Simultaneously, we should bring about a shift from scooters to bicycles. Similarly, there would have to be a shift from cars to buses for commutation. Barring very few exceptions we would have to banish cars from the roads. In order to effect this shift, we shall have to take two supporting measures. First all existing and intending car manufacturers would have to be asked to switch over their production completely from cars to buses. We would also need a much more rapid expansion of our bus manufacturing capacity. Secondly, the Central Government should give by way of grants, all the funds required to double the fleet strength of all our passenger road transport organisations - from about one lakh buses to two lakh buses - within the next five years.

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*By Dr. Narottam Shah, Chief, Commerce Research Bureau, Bombay, Member, Futurology, Technical Sub-Group on 'Energy'.

(vii) In General, for transport, for fuel in power houses, for feed-stock in the fertiliser industry and the petro-chemical and organic chemical industries, etc. we should make a determined effort to bring about a shift away from the petroleum products to coal. For, while we have little oil, we have vast reserves of coal.

(viii) By allocating requisite human and financial resources on a larger scale, we should accelerate our current effort to develop a suitable technology for coverting our coal into petroleum. Fortunately, the Central Fuel Research Institute, Dhanbad, has done considerable amount of spade work in this field. The work at this institute should be expanded several-fold and speeded up.

(ix) Hydro-power is, unlike coalor oil, an inexhaustible source of power. Besides, it is free of pollution. So we should strive to ensure the fullest possible exploitation of our hydropower potential in every corner of the country.

(x) We should also place greater reliance on nuclear power. But before we take a decision on any new nuclear plant, we should ensure that we have in our country our own capability to manufacture the requisite fuel from primary raw material and all the equipment, spares and components.

(xi) Other energy sources like solar energy, wind energy, tidal power, geothermal energy and MHD power generation are freely mentioned in this connection. But we should be realistic enough to realise that such sources can make a significant contribution in India, if at all, only in the next century.

(xii) Since so much of energy is required to transport man and material, the location of new economic units in the country and location of activities ina town should be so organised as to reduce to the minimum such transport of men and material. This promise has always been accepted in theory but ignored in practice. It is clear that we cannot allow this sort of situation to continue any longer.

All these are, of course, long-term measures. But it would be most unwise to defer immediate action on them just because these are long-term measures. On the other hand, since it would be long before we can reap the benefits of these measures, we shall have to take immediate and drastic measures to cut down our consumption of all petroleum products. In this connection, it is most unfortunate that the Government is doing precious little to meet this crisis.

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POSSIBILITIES OF SUBSTITUTION OF PETROLEUM PRODUCTS BY INDIGENOUS FUELS*

1. There appears to be some concern both on counts of price-hike and consequent higher foreign exchange drainage as well as scarcity of supply of crude for maintaning supply of increasing demands of petroleu-based energy fuels and feed stocks for fertilizer and chemicals. The widening gap between indigenous production and demand is being sought to be curbed by fiscal measures and perhaps introduction of rationing. The current penal imposition of excise on gasoline and equation of prices through excise of diesel and kerosene are evidences of such concern. In a recent meeting presided over by the Prime Minister equeries were also made about possible substitution of petroleum fuel by indigenous sources.

2. A survey of break-up of use of petroleum products would indicate that substitution of petroleum product is feasible mainly in public transport system especially on the railways where diesel traction can be replaced by electric traction. This, however, is a long-term proposal and there are obvious limits due to economic and capital investments for electrification of tracks. Nevertheless, a positive policy of accelerated maximising of electric traction must be accepted and implemented. Mere policy decisions are not enough. A phased programme has to be made. The mounting traffic load on railways demand more efficient and higher horse-power locos, which cannot be served by coal directly. The best efficiency of the railway locomotive is around 5% against diesel around 18 - 20% and electricity about 15%. The chief criterion of switch-over to electric traction is the density of traffic (a tonne per Km.) which decides whether electric traction can be economic. A policy was formulated about a decade ago which spelt that increasing loads on a line should be developed by diesel and should be followed by electrification as soon as the economic limits are in sight. However, savings that can be expected in this area can only be a long-term and will curb further demand rather than reduce current demands.

3. Gasoline which constitutes 7% of petroleum products currently consumed, is however, a non-replaceable fuel as far as prime movers are concerned. A switch over of mobile transport (on road) to diesel could create more problems than it would solve for it. It is easier to produce lighter fuels from a petroleum stocks than high speed diesel oil whose production is limited both by the characteristic of the crude and by availability of technology.

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45. Substitution such as by char-coal gas for vehicles is possible as an emergency measure, but is hardly practical.

5. There are possibilities of using more sophisticated fuels for road vehicles such as liquefied natural gas (L.N.G.) and even hydrogen or storage batteries or 'fuel cells' operating on methanol, hydrogen, etc., but none of the are yet commercial, and, therefore, cannot be depended upon for any immediate relief. However, these are areas for major efforts for research and development with a long-term perspective.

6. Kerosene, unlike in other countries, constitutes another major petroleum product consumed over wide areas in the country. No authentic survey exists in the country to indicate how much of kerosene is used for lighting and how much for heating or cooking.

7. That considerable amount of kersene used to find its way in diesel vehicle is known, which is now sought to be checked by imposition of excise and equation of price. However, a current survey indicated that Bombay city alone consumes over 15% of total kersene demand of India, iously being used for cooking. Taking the pattern of Bombay as typical, several other metropolitan cities perhaps will show similar features.

8. The kerosene fraction is also a fraction which provides with some modifications, the fuel requirements of aviation turbine.

9. It is presumed that a considerable amount of kerosene is used as lighting media in the rural areas though the quantum is not known. There can be no substitution of this requirement except by cheap electricity. It is generally taken for granted that electrification of rural areas will lead to savings in kerosene. However, some earlier surveys made by an oil Company in specific areas strangely enough, appeared to indicate the contrary.

10. However, the quantum of kerosene used as a fuel for domestic cooking can be entirely replaced by alternative fuels. In suburban, rural areas and smaller townships as well as for low income group citizens in metropolitan cities, it can be replaced by smokeless fuel produced from coal.

11. In the major cities where living is more on a vertical level than horizontal and with increasing pollution, the preference is for more sophisticated fuels as is evident from increasing popularity of LPG

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whose supply for domestic fuel is not only limited, but perhaps should be discouraged (LPG can be as good as a feed-stock for production of fertilizers as naphtha). The only substitute for kerosene for heating in major cities, is, therefore, gas and this can be produced from coal as has been done extensively for nearly a century in Europe where gas was first used for lighting and later for heating and then for industrial uses.

12. Only two cities in India, namely, Calcutta and Bombay have limited provision for piped gas supply but Gas-works could be set up in all the major cities with a population of say a million or more which will lead to several benefits, namely, (i) substitution of kersene, (ii) substitution of fuel oil, (iii) substitution for LPG, (iv) encourage small-scale industries, and, (v) combat pollution in cities, 60% or more of which is due to smoke produced from a variety of raw fuels. In addition the 'coke (a smokeless fuel) can be distributed both in the townships and suburban and rural areas around the cities, then the cities will serve both as storage dumps as well as processing centres. The gas tar oils could also be utilised as substitute for oil in power plants during emergency and of lean periods for gas. Tar oils (CTF) will serve as substitute for fuel oil especially where radiant heat is preferred (e.g. glass and ceramics, re-rolling and enamelling, etc.). Viable processes have been developed in the country and no importation of technology is involved. In fact, detailed project studies are available for immediate implementation.

13. However, generation of gas concurrently involves distribution unless the bulk is used at one source. The distribution net-work can follow other utilities such as water main, sewage lines or electric cables and is best undertaken by Metropolitan Development Authorities or Municipal Corporations or Corporations created for the purpose.

14. A substantial quantity of petroleum products consumed in the country is used in the form of fuel oil. Strangely, over 25% of this is currently used for power generation. Apart from a small percentage for essential uses, practically the entire amount could be substituted, at least theoretically, by coal for the major portion of fuel oil is used for generation of either steam or heat. In practice, however, it is extremely difficult to do so very often the equipment used (except for steam generation) is not amenable to be converted to the solid fuel firing- Once again the only substitute is gas and thus generation of gas is not only important for substitution of kerosene in domestic use, but also for fuel oil in the industries. That piped gas is a favoured industrial fuel when it is available is indicated that even for the limited supply of gas in Calcutta, nearly 2/3rd is used in industries.

15. There is still yet another avenue for saving of fuel oil and in fact all fuels namely, through fuel economy measures. Study of most industrial establishments show that a 20% saving is not impossible if fuel economy measures are adopted and trained personnel are used for control. But fuel and power constitute only 3 to 5% of the value of goods in most industries, the stress is only the availability and convenience rather than efficiency. Perhaps fiscal measures could promote fuel efficiency. It is felt that by combination of economy measures and substitution by gas, 50% saving in fuel oil consumption can be made and this could be further extended by increased availability of gas supply in industries in future so that demand of fuel oil for use as fuel is kept under check.

16. Two additional benefits from substitution of fuel oil saved could follow, namely, fuel oil can be hydrocracked for production of diesel or naphtha or it can be used as such for production of fertilizers. Both are feasible technologically and economically.

17. Total demand of petroleum feedstock for production of fertilizers and chemicals is of the order of 3 million tonnes. The demand of fertilizer in future will increase and an alternative feed-stock has to be explored. The preferred feed-stocks in order of increasing investment are natural gas, coke oven gas, naphtha, fuel oil, heavy residue and coal. Not so long back even wood gassification was restored to for production of ammonia in India, but this is no longer feasible. Of the feed-stocks mentioned above natural gas occurs in limited quantities only in Assam and Gujarat. It is not understood why maximum utilisation of available gas is not made for production of fertilizers. For example, gas is being used for power generation both in Assam and in Gujarat. As far as Assam is concerned enough coal is available as substitute for power generation.

18. As regards naphtha, there are rival demandson naphtha for (a) production of motor gasoline, (b) petro-chemical feedstocks and (c) fertilizer feed-stock. Gasoline cannot be substituted for automobile engines in near future except by diesel oil. However, it is possible to produce petro-chemicals from coal or coal gas and the question is one of priorities and investments. Petro-chemicals, fertilizers and energy fuels are in descending order of monetary value. However, a change in their relative values can have cybernetic inflationary effects on economy especially due to rising costs in transport and in agriculture.

19. Current technology and economics do not indicate that gasoline from coal especially from Indian coals

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can be competitive even at the higher costs of oil imported (although this does not take into account the constraint of availability of foreign exchange or its shadow value for imports). This Statement is perhaps no longer valid in view of unprecedented increases in price of crude following winter auctions).

20. It would, therefore, appear the balanced strategy should be to allow the transport sector which is vital not only for distribution and delivery costs of all consumer goods, but also for its very large employment potential, to have the benefits of cheapnfuels even based on imports.

21. As far as petro-chemical and fertilizers are concerned, there should be a strategy to utilise wastes of refineries such as refinery gas, LPG and natural gas, etc. whenever available and coal whose occurrences are fairly wide spread and abundant in the country.

22. However, in production of fertilizer based on coal a departure from current policies is recommended and in integrated approach where energy, liquid fuels, petrochemicals and fertilizers are produced based on coal is suggested as illustrated in the enclosed appendix.

23. Summing up, there appear to be several measures which are immediately feasible and may partially relieve the situation namely.

(i) To set up gas-works in major metropolitan cities to substitute kerosene, LPG and fuel oil for domestic as well as industrial uses. In due course these can be followed up with interconnected gas grid (like power grids) covering regions where base-load gas could be generated at the pit-head and peak-loads will be supplied by city gas plant.

(ii) The smokeless solid fuels (coke) produced could be distributed to lower income groups and then to adjoining rural areas around the cities.

(iii)Smokeless fuel can be produced in addition to gas works coke by several other techniques such as low temperature carbonisation, pelletisation, etc., briquetting which could be undertaken on smaller scale of say, in units of 100 tonne per day capacity and can easily cover the requirements of smaller cities and townships.

(iv) The problem is not technology, but availability of coal and transport as well as Government decision to invest or to encourage investment by private sector undertakings in production of smokeless fuels, gas-works.

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(v) In addition gas produced from fermentation of farm and city wastes could be set up in different rural centres, especially in development blocks. Residues of fermentation plants are excellent organic manures.

(vi) Fuel economy measures could be enforced both by technical means such as inspection and licensing and by fiscal means to deter more extensive use of fuel oil. Concurrently, alternative gaseous fuel has to be provided for industries.

(vii) Technological and investment decisions should be taken to convert fuel oil and residue oils to middle distillates (diesel and kerosene)and rather than using it as fertilizer feed-stock as being currently advocated.

(viii)Public traction should be increasingly converted to electrification, not only the railway tracks perhaps also in the cities. They not only provide efficient means of locomotion but also pollution-free transport.

(ix) Integrated projects - coal-complex - COALPLEX in some countries - producing electrical energy, piped gas, fertilizers, petro-chemicals and some liquid fuels can be conceived of even with available technology. Such complxes can also be switched over to production of energy fuels for emergencies.

(a) Long term programmes of research and development for new type of non-fossil fuels such as hydrogen and fuel cells and conversion of coal more economically into energy fuels, namely, high Btu gas (equivalent to natural gas), gasoline and fuel oils should be actively pursued. Delays in investment decisions in these fields may cost the nation dearly.

(b) The immediate stress is on coal for supply of all types of energy (electricity, coke, gas, petro-chemical and fertilizer feed-stocks). Therefore, the costs of coal and its production and transport are also important factors which cannot be ignored or allowed to take its own course if any energy policy is to be based on coal.

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24. It is true that coal is a 'dirty petroleum'. To refine coal into petroleum in chemical terms, merely involves elimination of a few percentage of oxygen and addition of 7 - 9% of hydrogen. But the processes are costly due to bulk handling and the number of steps involved. Also, the quality of Indian coals and the nature of the deposit are not comparable to the resources of United States, USSR or China. Most of the coals are low grade containing high ash and moisture. Thick seams when they are near the surface offer a major advantage in mining, but the same seams when they have to be followed underground provide a serious handicap: hence any coal based plant for energy must be taken into account not only the refractoriness of coal for conversion to organic liquids or gas, but also the problem of its quality, mining and transport.

CONVERSION OF SOLAR ENERGY THROUGH PHOTO SYNTHESIS : THE CONCEPT OF ENERGY OR FUEL PLANTATIONS

In tropical countries like India, the Sun provides a vast and as yet untapped source of energy. Solar energy is not only pollution-free and ecologically balanced, but its exploitation has the advantage over other sources of energy in that it does not involve the depletion of any scarce natural resource. The problem so far has been to convert solar energy into useful forms like mechanical work, electricity and localised heat. In addition to this, we have yet to develop adequate, inexpensive methods for its storage, since the availability of sunlight is highly variable, not only by the hour of day, but also seasonally

2. A good amount of R&D effort has already been devoted to the collection, conversion and storage of solar energy. Reflectors, black surfaces and lenses have been used for concentration and collection. Heat engines, photo-voltaic cells and solid state devices have been investigated to maximise conversion efficiencie Work is in progress in many countries on storage devices such as batteries, fuel cells and pumped water. Most of these programmes are designed to develop new technologies.

3. An alternative approach possible is to develop methods for solar energy utilisation which either make direct use of the heat of sunglight, or use conversion techniques which are already avail able. For instance, the manufacture of salt by evaporation, and the drying of grain by solar heat can, and already so, substitute for methods to achieve the same results which are presently based on the use of electricity or fuel. Even more important, since the technologies of power generation from the combustion of fuel are already well established, it should be possible in many cases to use the same technologies, with minor modifications where necessary, and instead develop new sources of fuel.

4. One possible method to produce such fuel is through photosynthesis. This could be converted either into electricity by burning or into liquid fuels or combustible gases through fermentation or other chemical processes. The conversion products, rich in energy, can be used more or less directly as substitutes for fossil fuels. In an overall sense, moreover, the fuels produce by this method are not only "renewable", but could relieve t pressure on fossil fuels in so far as they would also be available as substitutes for the non energy uses of fossil fuels, suc such as the production of petrochemicals.

5. The advantage of this approach is that, while technological methods for the conversion of solar energy may promise higher eff ciencies per unit area (although these have not yet been attained), they are still far from being fully developed. The

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technologies which could use the fuel produced by photo synthesis are not only available, but are already widely deployed.

6. The concept of actively growing plants for conversion into electricity in a thermal generator or into liquid fuel by fermentation is not new. Several proposals have been made for the setting up of "Energy Plantations" and "Fuel Plantations", and some of them describe the kinds of technological inputs needed. These appear to be reasonable and within reach. The decision to explore these possibilities must, however, rest on the economics of each situation. Photo synthesis is not very efficient in itssuse of land area. The production of fuel or energy if it is to be pursued, should yield a value ("rent") which is greater than that yielded by possible alternative uses of the land, such as agriculture, construction, etc.

7. We have worked out the amount of photo-synthetic energy available froma given land area, and we feel that this technology is worth investigating further. In India, some 600 calories are received daily on each square meter at the earth's surface. With a photo synthetic conversion efficiency of .5%, this would make available 3 cals/cm^2/day or 30 Kcals/m^2/day.

8. Thus, a year's production from a square meter would be approximately 10,000 Kcals. Since petroleum crude oil has a calorific content of some 10,000 Kcals/Kg., one square meter can, photo synthesis, produce approximately 1 Kg., one square worth of oil in terms of its heat content. Of course, the energy utilised in collection, transportation and processing will reduce this considerably, so a realistic figure might be an oil equivalent production of about 500 grams per square meter per year. This equals 5 tonnes of oil per hectare per year. The oil thus obtained will have to be refine to yield the required distillates, and is, therefore, a "Crude". Its calorific content (but not its molecular composition) may be assumed to approximate that of petroleum crude for which it would substitute. Thus, the value at present crude prices of 10 dollars a barrel would come out to approximately 350 dollars/hectuare/yr. in oil production, or Rs.2,800/hectare/yr.

9. The economics of plantations to produce solid fuel for thermal power plants have been worked out by Szego and Kemp (Chemtech, May 1973). They claim that a 400 MW generating station can be fed perpetually by a 400 square mile plantation of fast growing trees : 1 MW per square mile, or 4 kw per hectare. This would yield 32,000 KWH per hectare per year - a value of approximately $ 400 per hectare or Rs.3,200 at present $ costs of generation.

10. A working plant of a producer gas powered 100,HP generator, using wood as fuel, has been tried out by Shri D. Balasundaram at Madras. The cost of electricity works out to 16 paise/KWH.

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Although this is somewhat higher than the cost of other modes of generation, it would be useful to try out larger pilot plants in order to obtain the economies of scale. Using a 2 hectare 'agati' plantation, Shri Balasundaram claims that a 100 HP capacity producer gas based plant can generate electricity all the year round. Other species of fast growing trees are also available, for instance, in Rajasthan.

11. The assessment of these alternative uses of land can be carried out using the techniques of benefit/cost analysis. The benefits and costs can be evaluated using shadow prices which reflect the full opportunity cost of using the land in any particular way. At present, although land in India is not scarce, land (where such plantations could grow), with a sufficient amour of water, is. This kind of land can produce grain or cash crops. One hectare of land is capable, on an average, for instance, of producing some 3 tonnes of grain a year. At present market price for inputs and products, one hectare can earn on an average some 4,000 rupees. This would be its rental value.

12. Thus, since oil or energy production from land must have a value greater than the value of the grain it could produce, we find that on an average the above proposition is marginal. That means that in some parts of the country, land could not be diverted for fuel production of this kind while in others, it might well be the best use to which land could be put. As the international prices of crude oil rise, the proposition would become more and more attractive. This would become all the more so if the production of fuel could be made somewhat more efficient. This is an area for further R&D.

13. The concept of energy and fuel plantations has many variations. At the one extreme, we could set up a large super thermal power station in the middle of a forest. With appropriate choice of plants, it could be fed perpetually by a plantation covering four or five hundred square kms. At the other extreme, electricity could be generated in small scale plants providing electricity for local village use, fed by plantations of three or four hectares. Similarly, on scales ranging from the small to the very large, oil refining could be utilised to provide fuels from photo synthesis for transportation, petrochemical industries, etc. In all probability, the greatest pay offs can be had by combining the conversion of a given crop (sugar cane, corn, wheat, etc.) into both food and fuel.

14. From an ecological and environmental point of view, this method promises much. From an energy point of view, it is quite feasible and has very short gestation periods. It also eliminates the storage problem in a very elegant and simple manner. However, the economics and the biology/plant physiology of the process would have to be looked into in much greater detail.

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15. It should be recognised that in evaluating the alternative uses of land, one must also take account of the externalities brought about by each method. For instance, the environmental impact, good or bad, should be included. This is rarely easy to do, but even a subjective evaluation can be helpful. For instance, an energy plantation being nothing but a well managed forest, will not only provide fuel the value of which can be calculated at market prices, but also will act to conserve soil, improve the water balance, affect the micro-meteorology of the surrounding area, provide a habitat for wildlife and possibly a place for recreation. On the other hand, the pressure on our forests is so great, and promises to increase so much in the near future, that adequate protection of the plantation will also have to be provided and taken account of in the costing.

16. On the face of it, this kind of an approach cannot be ruled out a priority. We would recommend that research be carried out in the following areas :

(1) Plant physiology studies to determine the best species to maximise bioproduction in each ecological context. These should also attempt to maximise calorific content in the case of energy plantations, and optimise molecular composition in the case of fuel plantations.

(2) Economic and geographical studies to determine the areas most suited for plantation of this kind, minimising the opportunity costs involved.

(3) R&D to modify designs of furnaces and boilers to take advantage of the new fuels.

(4) R&D into the chemistry of fermentation and refinement to produce liquid fuels from wood and plant material.

(5) Design of plantations from the point of view of minimising costs of collection and transportation of fuel.

17. We understand that there are several species of fast growing trees available in the country. We would, therefore, further suggest that a small-scale energy plantation using a suitable power generator be set up immediately as a pilot project to study the feasibility of this approach.

TOWARDS A NEW RELATIONSHIP BETWEEN ENERGY & MAN

During much of 1972, we faced substantial cuts in the supply of electricity to the various power systems and hence ther was considerable dislocation of industries in the country with consequent loss of production. At that time, the question appeared to be merely one of excessive dependence on rain fed hydro electric power stations which proved to be disastrous in a year of general drought in the country. Added to this was also the fact that coal fired power stations did not perform as well as expected due to a number of technical problems and in some instances, there was a problem of making available adequate quantities of coal at the consumption points. In 1973, a completely new problem in energy situation has suffaced and this deals with oil. In the last few years the price of oil had undoubtedly been steadily rising but after the middle-East crisis developed, the price of oil has increased many times overnight. The countries in the middle-East have embargoed supply of oil to some countries in the world and reduced the quantum of supply to some other countries. So far as India is concerned, in the immediate context, it is not the availability of oil that is a problem as the price at which it will be available.

2. Most Planning in the field of energy in the last 10 to 15 years in India has been on the basis of steady exponential rise with doubling times of the orders of 7 to 8 or 10 years. It is interesting to note that rather similar growth rates were being forecast even in countries of Western Europe and U.S.A. which have already reached a high level of per capita consumption. Most people concerned with energy planning have hitherto taken a purely technological view of the problem and looked at how rise in demands can be met say by an accelerated programme of utilising traditional energy sources or by developing new energy sources such as nuclear power. The study sponsored by the Club of Rome which is reported in the book, "Limits of Growth", focuses for the first time the fallacies inherent in postulating an ever increasing pattern of growth and pointed out that pollution as well as the sheer depletion of physical resources of the earth would set limits to growth.

3. The International Federation of Institutes of Advanced Study (IFIAS), which has as its members a number of Institutes of Advanced Study in many fields from different parts of the world, considered that it was opportune to bring together a panel panel of experts to discuss the implications of choices, energy and man. The IFIAS is a non-Governmental organisation and is transdisciplinary and trans-national. The Tata Institute of Fundamental Research, Bombay, is the Indian member of IFIAS. The IFIAS had taken this decision to convene a panel on Energy and Man sometime ago and the panel discussions took place in the first week of December 1973 at Copenhagen. Although the objectives of the IFIAS study are of a long range nature, the

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current energy crisis facing many countries of the world justified justified the appropriateness of such a discussion. Experts from a number of countries, including U.S.A., U.K., Canada, Denmark, Holland, Sweden, Japan and India participated in the discussions in their individual capacities. The author of this paper was the participant from India.

4. There is very great diversity in the quantum of per capita energy consumption amongst the different countries in the world. Thus, for instance, in 1970, the per capita annual use of energy in terms of coal equivalent was 11,128 Kgs. for U.S.A., 4.436 Kgs. for U.S.S.R., 3,215 Kgs., for Japan, 522 Kgs. for China and 189 Kgs. for India. It is clear that within the national framework itself also there is considerable diversity as for example between an affluent urban dweller and a low-income peasant in the country-side. If we look at the consumption pattern of energy in the different countries, there would undoubtedly be very great diversity. For instance, in a country such as Denmark half the total net energy consumed is used for comfort heating. On the other hand, if we look at the consumption of electric energy (not total energy) in India, industrial consumptionaccounted for 73% of the total in 1970-71 and this is expected to go down to about 69% in 1990-91. Domestic consumption was 13.33% in 1970-71 and is expected to account for 8.11% by 1990-91. Inspite of the strong industrial nature of Western Europe and North America, the share of domestic consumption of electrical energy would be substantially higher largely due to various labour-saving appliances and the use of comfort heating or air-conditioning. The availability of fossil fuels such as coal and oil at relatively low prices resulted in tremendous promotional activiti vities on the part of the electric supply industry in North America and Western Europe. For example, it is common knowledge that in the affluent parts of the world such as North America and Western Europe, comfort heating standards have been such that it has been possible to do away with the use of warm clothing inside dwellings even in the coldest winter. Strangely and unfortunately, a perverse corollary to this has been that even in relatively mild weather conditions, where one would be expected to be comfortable in light clothing and without energy inputs, the use of air-conditioning to the extent that people actually have to use warm clothing or blankets has become fashionable.

5. The pattern of living of the urbanised parts of the world, whether in the developed or in the developing countries, has been conditioned by the abundant availability of cheap energy resources, mostly in the form of petroleum products. Thus the vast agglomeration of inhabitants in big cities like New York or Tokyo or Bombay would not have been possible without the infra-structure of trucks brining in food and other articles of necessity into the urban metropolis and of the motor cars and trains which take the people to their places of work, often many tens of kilometres away from their residences. The architectural styles currently in vogue are also such

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that they can be sustained only on the basis of profligacy of energy. Thus dwellings in warm countries with large glass curtain walls let in all the solar heat while effectively keeping out the breeze which could have carried away the heat. Dwellings in cold countries are no more efficient from the point of view of keeping them warm in the winter.

6. It appears that the question relating to oil is not a transitory phenomenon but a permanent one and will require a qualitative change in the way of life of people everywhere. The changes demanded would of course be more drastic in such co countries and societies which have become very heavily urbanised or which have become highly industrialised and dependent on imported energy. Most economic planners have looked upon the per capita energy consumption as an indicator of the well being of a society. Historically, there has been a discernable relationship between the per capita energy consumption and increase in Gross National Product. There is, however no 'a priori' relationship between energy consumption and GNP except that productivity of many processes registers a big jump when there is a switch to high energy consuming technology. The availability of cheap fossil fuel has undoubtedly contributed to the growth of economics of north America, western Europe and Japan. The steep increase in price of oil fuel which is now taking place would undoubtedly make the task of development in developing countries such as India more difficult than would have been the case otherwise. In India, for instance, much of consumption of petroleum products is really in vital sectors of the economy. For instance, as of 1970-71, motor car fuel (i.e. petrol) accounted for only 8% of the total consumption of petroleum products, whereas the rest was accounted for by kerosene, high speed diesel oil, naphtha, furnace oil, etc. The higher cost of energy input would, however, indicate different optima for investment decisions. There is some prospect, though uncertain, that the oil producing countries in the middle-East might be persuaded to have a dual pricing policy whereby they might charge a lower price to the developing countries and if this were, in fact, to take place, then undoubtedly it will be most welcome to the developing countries who are at present in the process of their primary industrialisation. It will be prudent for India to switch over to coal as a feed-stock for fertilizer plants. We have been seeing many shifts in the policy of feed stock for fertilizers over the last ten or fifteen years. India had one of the early coal based fertilizer plants at Sindri and subsequently a lignite based plant was built at Neyveli as part of the integrated complex. Although these plants had considerable operational problems, the decision to abandon the coal based fertilizer plant at Korba in the early sixties was unfortunate. While subsequently three coal based plants at Ramagundam, Talcher and Korba have been taken up, we seem to be currently commiting to a

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large number of fuel oil based fertilizer plants. This plan should be reexamined in the light of the rising prices for petroleum products. In the long run, it is clear that we should use coal as the preferred feed stock inspite of the technical problems and the larger capital cost of the projects.

7. While making a transition from a traditional economy to one based on modern science and technology, it will be useful to keep in mind some facts about the energy intensiveness of the so called modern methods of life. For example, it has been estimated that in modern agriculture as practised in the U.S.A. the input of chemical and mechanical energy is about five times as much as the energy recovered in the food. The ratio is much higher in case of high protein foods. As compared to this, in traditional rice cultivation as practised in India or China, the chemical and mechanical energy put in (excluding the input of energy by way of human labour) is estimated to be of the order of 1/50th of the energy in the recovered food.* In other words, in the traditional technique, a very large part of the energy is in fact received from the sun. Similarly, the products of a high technological socety such as automobiles, plastics and other synthetics are extremely highly energy consumptive. The problem of sustaining a high level of consumption of articles produced by modern industry on a global scale becomes extremely difficult, if not impossible, when one keeps in mind that there is also a high degree of absolescence built into the product in order to keep the wheels of industry going. For example, the replacement of furniture made by wood with furniture made in steel or in plastics would indeed involve a significant additional input of energy in the process of conversion of iron ore into steel and finishing it into tubes in the one case, and of converting wood into plastic and thereafter moulding it into the finished shape or form in the other.

8. At the discussions of the IFIAS, there was a report about the energy policy project carried out in the U.S. under the auspices of the Ford Foundation, wherein a number of scenarios for the future are examined. One of the scenarios chosen for the study is the so called 'business as usual' scenario wherein the continuation of the present trends of energy demand is postulated and this would imply energy consumption of about two and a half times the 1973 figure in the year 2000. It may be remembered in this context that the U.S.A. with about 6% of the world population is at present using over 1/3 of the total energy used in the world. The second economic assumes that the rate of rise of energy consumption would be held down by fairly straight forward steps like increasing load factor in private automobiles from the present 1.3 to 1.9 reduced temperature in the homes in winter and such other fairly obvious economy measures. It is estimated that on this basis the demand

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*There appears to be some argument as to these numbers amongst experts. Even if we were assume that the first number is an over-estimate and the second an-under-estimated, the qualitative arguments remain essentially valid.

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projected for the year 2000 would be reduced by about 30 to 40% of the 'business as usual' target without the life style changing significantly. Two other scenarios in which there is only a marginal increase in the total U.S. energy consumption from 1973 figure to 1985, which remains static thereafter and another wherein there is in fact a declining trend of energy consumption after 1985 have also been examined. While these studies are in progress, it appears the there is no obvious decrease in the GNP merely because of a decrease in energy use. However, it is clear that in a highly consumption oriented economy such as in U.S. it would involve very extensive public education to get the peopole to now accept a different outlook. But the authors of the energy policy project hope to mount necessary public education campaigns for this purpose.

9. The discussions at the IFIAS panel indicated that although there is a reasonable welath of statistics relating to patterns of energy use in many parts of the world, there is still a great deal of inadequacy of information about the energy content of various products and processes. Indeed, there might well be no universal law in this as the social frame work o of different countries would also affect the pattern of energy consumption in different products, processes and services. The IFIAS panel after due consideration recommended that an energy accountancy project might be taken up in Denmark as a case study particularly because there is a mass of statistical information available readily and also because it is a typical energy importing country. It would appear that in our own context it will be desirable to initiate a similar energy accountancy project to cover various fields of activities such as agriculture, industry, transport, domestic consumption etc. so that we can have objective information available when making decisions relating to energy consumption patterns.

10. Looking at the energy picture as a whole as it affect India, it is clear that the trend of rising petroleum consumption for road transport which is a historical process in the last 10 or 15 years will now have to be reversed as the country will not be able to finance petroleum import in increasing quantities when faced with steadily increasing prices. This would mean that we have to depend more heavily on rail transport. Indeed, early action to increasingly use electric traction is urgent. In the past when economic feasibility studies have been carried out about electric traction, the conpetition from road transportation rendered some of the schemes not so attractive. In future, however, electric traction will undoubtedly appear to be the most advantageous. So far as electric power itself is concerned, we will have to develop all available hydro electric resources as in fact has been the policy till now, coal fired power at or near pit heads and nuclea nuclear power in areas remote from coal fields. There would have to be reversal of the urbanisation process that has been going on in a relatively unplanned manner in post-independent India. Industries must be spread around the country so that small and medium size towns develop as opposed to large urban metropolises like Bombay, Calcutta or Madras. The large cities

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are particularly profligate in energy consumption. In achieving this de-urbanisation it is clear that we may have to modfy our existing licensing practice whereby industries are allowed to come up near the large urban centres and in fact give ne necessary financial and other incentives for even existing industries to move out. Urban administrators often argue that location of new industries or business premises give to the city badly needed revenues thus enabling them to take on urgegtly required development work in the city. Such calculations ignore the very heavy expenditure on infra-structure for supporting more industries or business houses and of course take no note whatever of the social costs of urban slums and delinquency. Even a measure of conpulsion in the de-urbanisation process would be justified when we look at the over all costs to society. It should be the aim that most persons who work in a factory or in an office are able to walk down to their places of work or at least be able to traverse the distance on a bicycle. In fact, the growth of the larger private and public sector industry in India has largely been in new virgin areas where medium sized new townships have sprung up and this trend should be continued. All inter-city transportation would largely have to be through the railways.

11. We may expect to locate additional resources of oil within the country. If this turns out to be the case, we could cut imports to a corresponding extent. Hoever, the demands for feed stock for fertilizers and petrochemicals are expected to rise to an extent that it may not be feasible to contemplate use of oil as an energy source as has been hitherto customary. With regard to off shore oil, the current indications off the west west coast of India are encouraging. Large scale exploitation of off shore oil however will require massive investments and the technology itself is still in the process of development. There also appear to be significant environmental risks involved by way of blow off or pipe line breaks which require to be fully assessed before large scale exploitation of off shore oil is established.

12. In so far as rural life in India is concerned, there has fortunately not been a great impact of modern life styles except that the use of chemical fertilizers has been growing and that irrigation pumping by electricity or by oil fuel has been spreading. It is clear that we will have to continue to provide the necessary nitrogenous fertilizers whose use rate is substantially less than it is around the world and also to provide the motive power for irrigation pumping. However, it is clear that there would be no strong case for a tractor revolution in the country as in any case the small size holdings typical of Indian agriculture are best looked after by continuing to depend depend on animal power. Similarly, transportation in rural country side need not make a transition from the bullock cart age to the motor car or truck age. Instead, it would be

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*It may be noted that in some instances rubber tyres are being used used in India. However, this has been done on the basis of using discarded car or truck tyres. If the tyre and wheel are specifically designed for the purpose, it could be much smaller in size and diameter and could be produced on a large scale more economically.

adequate if we use fairly elementary technology by way of replacing the steel tyred wooden wheels of the bullock carts wit with rubber tyres.*To achieve this, however, it will be necessary to construct reasonably surfaced roads for carrying the light loads of such carts. The absence of such simple roads has also prevented the use of even wheel barrows much to the discomfort of the village farmer.

13. One of the simplest ways in which solar energy can be put to use is through the process of photosynthesis. In fact, we still depend to a large extent on fire wood which is used as a source of fuel in many parts of rural India apart from cow dung. If there were proper husbanding of the resources that is to say a proper balance between reafforestation and felling, there should be no ecological imbalance. However, unfortunately, due to the rising population pressure there has been indiscriminate cutting of the forest wealth of the country which cannot be allowed to go on. The technique of exhorting people to plant more trees used over the past ten or twenty years has not produced adequate results. The present situation warrants deployment of unemployed youth and school and college students to spend several months every year on planning and tending of trees. It would appear that while soft coke or coal gas could be made available as domestic fuel in small and medium size cities, domestic fuel in large parts of rural India, away from coal fields, will continue to be based on agricultural products. If the population of the country were to reach some stable level, which all planners and well wishers of the country would fervently hope for, then it may be possible for us to have a planned use of fire wood as a source of domestic fuel. In any case replacement to a great extent of fire wood which is being used in substantial quantities in the country as a whole by commercial energy sources such as soft coke or kerosene seems to be extremely difficult, if not impossible. In addition, it is essential that we resort to use of the gobar gas plants extensively so that cow dung is not burnt away as it is now. The gobar gas would not only provide rural domestic fuel but also prove to be a vluable fertilizer. Similarly all medium and large sized towns should have sewage treatment plants which also produce town gas which can be used as a source of fuel.

14. In the long run apart from increase in the use of nuclear energy, we expect that geothermal energy may also contribute in some parts of India. Fusion energy may be expected to be exploited at least by the year 20000. There would appear to be a strong case for us to embark on the exploitation of solar energy having regard to the large tropical land mass of India. Existing power generation technologies favour centralised generation and a fairly extensive distribution net work becomes, therefore, necessary. In the case of solar energy, the fact

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that it is widely distributed to beging with should make us look at solutions which would permit conversion to other forms of useful energy locally. For example, would it be feasible to generate electric power for lighting of homes or running a pump without having the source of power connected to a grid system? If such a solution were possible, then one could visualise solar energy generators in large parts of India. It appears that solar energy could also be used for metal smelting and refining. While the techniques have been used for special applications on small scale, development efforts are called for. Wind power may play quite an important role in the coastal areas of the country where there is a steady wind most of the time. Here again, the effort should be to utilise the energy at source say for lighting or for pumping of water, without any attempt to produce large quantities of power requiring subsequent distribution. The scattered nature of our rural communities would favour exploitation of solar and wind energy on a local basis.

15. We would also have to embark upon development of other types of motive power for small personal vehicles such as small size city cars which could be either electrically operated or driven by a fuel cell. Even if considerable extent of de-urbanising is achieved and highly efficient public transport systems are evolved, it would still be necessary to have transportation within cities either for personal use or for taxi use which could be run by some fuel other than fossil fuel. The life style as it obtains now in the West is highly travel intensive. The more affluent in India have also got on to this habit of life. It is worth examining whether business and governmental transactions could not be carried out with equal efficiency by moving information as opposed to moving people. Electronics communication is a remarkably low consumer of energy and could substitute a lot of present day travel. It would also be appropriate to realise the value of human muscle power. It is perhaps the most efficient source of power for travel so long as the distances are not long or for various other activities like lifting light loads or pushing hand carts. While external energy inputs and modern tools relieve the drudgery of back breaking physical work, the pendulum has swu swung too far the other way in affluent societies. For instance, many people in north America have such a sedantary existence that they actually have installed in their basements a stationary bicycle which is peddalled vigourously for some time in order to promote blood circulation in the limbs. Classical economists would no doubt consider manufacture of such stationary bicycles as additing to the GNP and the workers employed on such manufacture as 'gainfully employed'. When one takes a more fundamental look at the matter, it is clear that this activity is comparable to building sand castles on a beach ! This is only one instance and there would be many similar examples.

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16. The Indian economy is at present at a state where deliberate policy options on the energy front can be implemented without too much difficulty. There has to be an increase in per capital energy consumption as this is required even to provide the basic necessities of life such as food, clothing, and shelter and replace manual labour in a number of activities where it is much too onerous. We should guard against making panic decisions when faced with a crisis situation which might foreclose future options. We should make such choices as would not only ensure a desirable level of human happiness and comfort but also be in balance with nature. While some of the choices have been discusssed in the paper, it is proposed that we embark on a scientific study of the kind of life styles that we should plan for having regard to conservation of material resources, of which energy is one of the most important. The present generation of mankind should look upon itself as a trustee of future generations so far as the irreplaceable resources are concerned. It has to be recognised that the energy situation can cannot be looked at in isolation and has to be viewed as part of of a whole system consisting of urban and rural life styles, pattern of industries and services, farming practices, methods of transportation, types of building construction, town planning and such other factors. Before embarking on such comprehensive study we will need detailed information and data on the use and effectiveness of energy inputs into various activities including agriculture, communications, industry, domestic usage, entertainment etc. Hence as mentioned earlier we should embark on an energy accountancy project at the earliest to be followed by the comprehensive study. It is however clear that we would have to utilise technology at two levels. Simultaneously in many activities. For instance we would have to use animal power on the farm and for rural transport of goods while at the same time using electric traction on the railways. Similarly we have to use gobar gas as domestic fuel in the villages while turning increasingly to nuclear energy as a source of electric power. We have to carry out research and development for harnessing fusion energy while at the same time finding out improved methods of putting to use solar energy and wind power. The history of technology over the last fifty years has been that the latest technology generally displaces the earlier technology. We have to abandon this classical approach and look upon the old and new technologies as complementary and use them in a judicious combination.

17. Finally there is the question of interdependence. While the energy consumption in the developing countries has to increase from the present low levels merely to ensure a minimum acceptable standard of life, the energy consumption in the developed countries cannot increase in the manner it has been doing over the last twenty or thirty years. If the present rate of growth in energy use is maintained in the developed world, there is a grave danger that thermal and pollution limits might we will be reached in a matter of 100 years or so, even assuming that energy resources did not pose a limit. It is

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clear that just an inequalities between different parts of a country cannot be sustained, so inequalities in different parts of the world cannot also be sustained. It is not suggested that the per capita energy consumption in different parts of the world should be exactly the same. It is clear that climatic differences demand some differences in the pattern of energy consumption from country to country and indeed within a country. However, the wasteful use of energy in affluent countries and the affluent parts of the developing countries will require to be stopped. Just as uncontrolled population growth in the developing countries of the world cannot be sustained ina finite earth so uncontrolled growth of use of energy in the developed of developing parts of the world cannot be sustained.

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ENERGY SCENARIO FOR THE YEAR 2001.

by

Shri H.R.Kulkarni.*

Role of Energy:

Energy is the basic ingredient of life and hence of human progress. Muscular power which man is endowed with and which along with animals is the means for his living, is derived from a metabolic process of the food intake. Man, however, has used his distinguishing gift of the power to think, and has harnessed various other sources of energy for his own benefit. The additional energy consumption is therefore an index of his prosperity - which is the acquisition of material comforts and services with least expenditure of his own energy.

Pursuit of prosperity has meant access to and utilisation of larger and larger quantum of energy. The materialistic world of today is built on this premise and its success is resoundingly demonstrated in the so-called economically advanced nations of the world. The underdeveloped or the backward countries have been dazzled by the material progress of the advanced nations and have been willy-nilly trying to follow in their footsteps. Whether advanced nations have really gained greater "Happiness" - which seems to be the admitted philosophical goal of man - may still be a moot question. Nevertheless pursuit of material progress for better and more creative comforts, seems to have fired the imagination of all the peoples of varying shades of backwardness. While some may like to put a limit to the pursuit, in relation of the quest for happiness, what that limit should be seems to have eluded comprehension so far.

Bases of Projection:

The energy scenario for the 2000's therefore can be attempted in at least three ways:

(a) A scenario which assumes the pursuit of material progress to continue untempered by any philosophical questioning.

(b) A scenario which, while assuming material advancement most desirable, recognises that it cannot be endless and must have a limit, primarily determined by the earth's - or for that matter a nation's - material resources, and the need for their conservation for posterity.

(c) A scenario based on acceptance of human happiness not being dependent on material prosperity but an attitude of mind, which can be cultivated.

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While the scenario(a) is the simplest to paint, being more easily susceptible of logical extrapolation, the scenarios(b) and particularly(c) call for great thinkers who can exercise a powerful influence on human thought,(b), however, can be conceived as a compulsion of natural forces.

Scenario(a)

Since energy is only a means to an end - a physical goal to be more precise - thepart it will play on the canvas of the 2000's will depend on the broad objectives of the scenario to be painted. Since in this scenario, the basic objective is material prosperity, the only constraints will be our limitations in the speed of achieving progress and the availability of exploitable - exploitable within the time frame under consideration - resources. We may therefore proceed on the basis of continuing the economic planning process already set in motion, gaining momentum with time and being guided by the egalitarian concept of the greatest good for the greatest number.

If Electrical Energy, which for the sake of brevity will be referred to (although not very scientifically), as power, is our main concern, we at once realise that this is only one of the forms in which energy is used and as such its role in the future is very much dependent on the role that other forms of energy will assume. This assumes that while the total energy consumption will rise to meet the set goals, the inter-se priorities for different forms of energy are still open to be decided, presumably in a scientific manner, to achieve the techno-economic goals, with due regard to resources and technology available.

In order to visualise the role of power in the future, it is therefore necessary to contemplate the entire energy spectum and make certain plausible assumptions regarding the role of other energies, their conversion, substitution, etc. Broadly the total energy consumption in India has been growing at an average rate of 4.5% over the ten-year period - 1961 to 1970 - compared to the average world growth rate of over 5% per annum.

The per capita annual energy consumption in the advanced countries was 4,730 kgce(kg coal equivalent) in 1967 when world average was 1,640 kgce. Even if the growth rate in India is maintained at 4.5% per annum the per capita consumption in India which was 712 kgce in 1970-71 will by the year 2000 by 1470 kgce which will be a far cry from the 1967 total per capita energy consumption of advanced countries ! It is interesting to note that although the total energy consumption has been growing at 4.5% per annum, which is not too low compared to the world average, the per capita energy consumption in India has been rising at about 2 to 2.2% per annum only over the past two decades in view of the growth of population itself at the rate of 2.4%. If this rate is maintained upto the year 2000, the per capita consumption would rise to 1,470 kgce, which is also the same value as derived from the annual total energy consumption growth rate of 4.5% per annum. This level of energy consumption will be only 30% of the level of consumption in the advanced countries in 1967. This clearly demonstrates that there can be no reduction in the growth rate of energy until the turn of the century, since the per capita consumption even then will be far far lower than that of the present per capita consumption in advanced countries. Even with quite a different concept of life style this consumption will not be unreasonable. This is on the assumption that our inherent capability for development is likely to limit the growth rate to the level accomplished in the past couple of decades. It would, however, be desirable to accelerate the development of energy consumption so that we can reach at least double the figure of per capita consumption indicated above which should take us to 3000 kgce per capita. We may thus work out two sub-alternative scenarios corresponding to these two objectives viz.(a1) raising the total per capita energy consumption level to 1500 kgce and (a2) raising it to 3000 kgce.

Assuming the population growth rate more or less similar to the present rate of 2.4% per annum the levels of national energy consumption will be as follows:

	World	India				
Year	1967	1970-71	1990		2000	
Population millions	3420	530	840		960	
			(a1)	(a2)	(a1)	(a2)
Per capita energy tcr	1.64	0.72	1.2	2.5	1.5	3.0
Total energy consumption mtcr.	5630	377	1000	2100	1440	2880

The energy consumption figures for India are inclusive of both commercial and non-commercial forms of energy but excludes animate energy. The latter may add another 0.15 tcr to the per capita consumption in 1970-71, but its contribution will taper off in the future.

The next question will be in what forms will this energy be used. This question may have many solutions, which will be consistent with different assumption on the national resources and the available technologies.

Primary Energy Resources:-

On of our hypotheses will be that we will rely by and large on our own national energy resources. This is predicted by the rising energy costs in the world and the paucity of our foreign exchange resources for import of energy from other countries at high cost. This again presumes that our export to other countries, including the oil rich countries, will continue to form a small, although increasing, part of the imports of those countries, thus entitling us to only a small share of the world foreign exchange. This partly a result of the need to satisfy our own increasing demands for our expanding population. Assumption of self-reliance in thefield of energy appears therefore justifiable especially in the light of the anticipated adequacy of our energy resources over the time span under consideration.

The energy resources of India, in the form of depletable fossil fuels and fissile fuels, as presently estimated are as follows:

Depletable energy resources.	Usual units	Coal replacement value
Coal	83 gega tonnes	83 gter
Oil(including 1000 mt off-shore)	4 gega tonnes	8 gter
Natural gas	63 gega cu.metres	0.124 gter
Uranium	22000 tonnes	
Thorium	450 mega tonnes	5000 gtcr*

* equal to 5 million Twh
5×10^6 mtcr.

Renewable energy resources

Hydro-electric (80 GW @ 60% L.F.)	420 Twh	420 mtcr per annum
Non-commercial resources	180 mtcr per annum.	
Animate energy **		80 mtcr per annum.

Shares of different forms in energy consumption:

The peculiarity of the Indian energy landscape is the consumption of large blocks of non-commercial energy in the form of fuel-wood, dung ard agricultural waste products. At present the non-commercial energy consumption is a little less than half of the total energy consumption. If animate energy contribution is also taken into account, the non-commercial energy consumption outweighs the commercial energy consumption. The sources of non-commercial energy are estimated as follows:

(1970-71)

Fuelwood & charcoal	--	117 mtcr
Dung	--	27 mtcr
Agricultural waste	--	36 mtcr
Animate	--	80 mtcr
Total		260 mtcr

Fuel-wood:

The lion's share of the non-commercial energy is contributed by fuelwood, which is largely obtained free of cost by unauthorised felling of trees from forests, roadsides and private jungles, and which accounts for about 90 mtcr out of a total of 117 mtcr. This has resulted in continuous denudation of forests, and the dwindling of theforest resources. While efforts should be made to have a well-planned aforestation scheme with specially quick-yielding trees suitable for fuels such as Casurenia, Cagery,Babul etc. this has only a limited scope, since the total area under forests in India can be put to better use for growing commercial timber, medicinal herbs, etc. The Fuel Policy Committee estimates that

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**This is estimated on the basis of 250 million cattle of which 40% are used for tractive purposes(allowing for milch cattle) and each head works for 8 hrs. on each of 200 days in a year and has 0.5 kW average power. This includes animate energy needed for farming as well as transport.

fuelwood resources can be developed upto 125 mtcr. It is estimated that the yield from social forests for firewood can be about 6 tonnes per year (on a ten-year cycle). This will require about 0.4 to 0.5 hectares of forest land per family, which is too large to be available except in some parts of the country. Fuelwood forests will/therefore be able to meet the /not rural domestic demand - with rising population in the future.

Animal Dung & Biogas

Of the total estimated dung output of 1250 mt which is equivalent to 250 mt dry dung, only one-third is stated to be used for fuel. Even if this proportion is raised, the limit will be reached soon unless it is envisaged thatthe already high population of the cattle is further expanded. If dung is preferentially used as manure, the bio-gas plant will enable this to be done without any sacrifice of the heating value that can be utilised. Assuming an enhanced efficiency of biogas production(at 35°C using solar or the heat source if necessary) of 0.6 m^3/kg. of dry dung, 210 mt of dry dung available* the annual gas production would be 125 billion m^3 of gas. This is equivalent to 125 mtcr. The capital expenditure involved for setting up biogas plants to utilise this energy is estimated at about Rs.11500 crores if individual plants are built or 3600 crores if community plants are adopted.

The coal replacement value of the present dry dung consumption for heating (at 11% efficiency) is 25 mtcr. Since only about 1/3rd is presently used for fuel purposes, its value if fully used, will be 75 mtcr. This is far less than 125 mtcr value of the biogas that can be generated from the same dung. Hence it can be assumed that even though dung will, in future, be primarily used as manure, the by-product biogas will be able to meet 125 mtcr of domestic energy requirement, on the presumption that the cattle population will remain steady at the present level of 250 million. This source of energy will thus make a substantial contribution of 100 mtcr of additional energy of additional energy for domestic consumption.

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*This is based on 250 million cattle reckoned at 70% of 16 kg. droppings per head per day yielding 1/5th the weight in dry condition.

Agricultural waste products :

Agricultural waste products can be deemed to be proportional to the area under cultivation, and a certain crop pattern. The waste yield may not be substantially different with newer high-yielding varieties and can therefore be more or less considered fixed at 35 mtcr. The availability of this resource can therefore be taken as constant in the future, since it may not be desirable to increase the area under agriculturalif forest area and woodland are to be increased for maintaining environment and climate.

The total non-commercial energy availability in the future can be taken as 235 mtcr comprising:

Fuel wood and charcoal	...	90 mtcr
Biogas from dung	...	125 mtcr
Agricultural Waste	...	20 mtcr
Total	...	235

This allows a 27 mtcr equivalent reduction in fuel wood consumption - expected from efforts to reduce indiscriminate feeling of trees for fuel, and reduction of 16 mtcr of agricultural waste which will be diverted to manure production.

Provision of 125 mtcr of bio-gas energy (including displacement of 25 mtcr of dry dung used for fuel) by full use of animal dung (ignoring for the time being the possible similar use of human excreta) should bring about a revolutionary change in the domestic energy consumption pattern. Of the total population of 980 million expected at the turn of the century, if 350 million lives in the urban centres (as estimated by Rashimi Mayur of NITE) the balance of 630 million can be assumed to be residing in rural areas. Assuming that biogas will be predominantly used in the rural sector by virtue of its economics, the per capita availability of biogas alone will, by 2001, be 0.2 tcr compared to the present per capita total consumption of 0.346 tcr in the rural sector. This increase will be over 55% and will also incidentally save indiscriminate exploitation of forest wealth. With the exploitation of the full potential of biogas, the rural population will thus enjoy over 55% more energy, and that too in a very convenient and clean form, and at the same time will have 115 million tonnes of additional manure equivalent to 1.6 mT of nitrogen for their fields. The corresponding coal saving for fertilisers will be about 7.5 mT per year. This is almost like "having the cake and eating it too." All out efforts for maximisation of utilisation of the biogas from the large cattle population must therefore be made.

This assumes that the economics of cattle utilisation will not be severely disturbed in the next 2-3 decades and the cattle population will at least stay steady at the present level. Of course more effective use of cattle by better breeding and better care can be assumed so that its utility for other purposes will be enhanced. If the rural energy requirements are pegged at about 2 kwhr/head per day, the biogas proposition will result in complete self-sufficiency of the village as far as energy is concerned, and will give rise to what J.C. Kumarappa called the "economy of permanence". It can at least be assumed that by making full use of biogas potential, the requirement of commercial energy in the rural sector will be small and may be largely in the form of electricity for pumping and lighting.

Commercial forms of energy:

This projection incidentally assumes that the energy consumption of the urban sector will have to be met from commercial sources of energy, which is logical. It is far more economical to supply commercial energy especially in the form of gas, in concentrated population centres. It thus becomes obligatory to supply commercial forms of energy to meet the balance of the demand, which will be as follows :

	1970	1990		2000	
		a1	a2	a1	a2
Total energy consumption mtcr	377	1000	2100	1500	3000
Non-commercial energy consumption mtcr	180	235	235	235	235
Commercial energy consumption mtcr (by difference for projection)	197	765	1865	1265	2765

It is now necessary to visualise how this commercial energy demand will be met, what primary sources of energy will be available for this purpose and to what forms of energy they will be converted for ultimate distribution and consumption. A review of (1) the energy resources already established, (2) the technologies available and (3) that may become available in the future for exploiting these resources, has to be made to serve as the basis for forecasting the energy scenario of the 2000's.

Hydro-electricity:

Hydro-electricity is undestandby the preferred source of energy as it is renewable, although it may have some concommitent problems of reliability. Hydro potential of 41 million KW at 60% L.F. was estimated in the Fifties. This corresponds to 216 Twh of energy per year, on a 90% reliability basis. Hydro utilisation by the end of the Fifth Plan will rise to 46 Twh which will be only 20% of the potential. Further, it is believed that if seasonal energy that can be generated when large quantities of water are available during monsoon is utilised, the hydro availability could be raised to well over 300 Twh and the installed capacity required for exploiting this energy (at L.F. of 35-40%) may be about 80 - 90 GW. Although these resources are largely concentrated in the Himalayas, and will involve long distance transmission of energy, there does not seem to be any technological barrier in the way of their full scale exploitation. If adequate financial resources are available, the bulk of these resources could be tapped by the turn of the century and we can assume 250 Twh of renewable hydel energy in use by them. This is equivalent to 250 mtcr. This leaves a balance of 980 mtcr of energy to be supplied from other commercial sources in scenario a1 and 2480 mtcr in scenario a2.

Coal Resources:

Reliance on coal has been advocated since our oil resources are admittedly small. Our resources of gas which are only 0.124 gega tonnes cr. are almost insignificant, especially after excluding associated gas from oil wells. It is therefore logical that this gas should be put to use as feed stock for chemical industries where its value is much higher. Use of gas as an energy resource therefore must be ruled out. At present the total gas consumption is 927 million cu.m. per year of which 430 million cu.m. is in Gujarat and 497 in Assam.

The estimated primary energy resources have been already given in the preceding paragraphs. It may be seen therefrom that our fossil fuel resources are not very large compared to global resources. Even assuming that our entire estimated resources of coal amounting to 83 gega tonnes (gt) are proved in due course - compared with the present proven resources of 23 gt - with the present mining technology, the actual coal recovery is 50-80% of the in situ resources that is, 20-50 of the coal is left in the ground after mining. Assuming an average recovery of 60% only 49.8 gt will be actually available for use. A substantial proportion of it will be of very poor quality having calorific value of

3500 kcal/kg. or less. Assuming an average calorific value of 4000 kcal/kg. the coal replacement value (which assumes 5000 kcal/kg.) will be 40 gt. Assuming that the coal production which is to be raised to 135 mt per annum at the end of the Fifth Plan, increases at 7% p.a. thereafter, coal production by 2001 would be around 675 mt/year. Of this about 450 mtcr will be used in the form of electricity. Assuming a 60% of thermal Power Stations operating in conjunction with 35% of hydel energy, the thermal installed capacity will be 85 GW. The total thermal and hydel capacity will thus be about 165-175 GW. Nuclear capacity will be on top of it. The balance of 225 mt of coal will be used directly or in the form of brickets or gas.

If this level of coal production and consumption is maintained thereafter, our estimated coal resources of 83 gt may last until the middle of the 21st century. This is on the assumption that the structure of the energy consumption does not change from the Fifth Plan assumptions. If coal is required to be used for large scale replacement of oil or non-commercial energy, the resources will be exhausted even earlier. On the other hand if new coal mining techniques improve the recovery percentage the resources will last longer. One conclusion, however, emerges and that is our coal resources will be able to supply the energy demands placed on it until the turn of the century and for some time beyond that.

Oil Resources:

Our oil resources are very meagre and of the estimated annual consumption of 32 mt in 1978-79 only 37% will be derived from indigenous sources. Even if the promising oil sites are fully developed, it will only help to maintain the present prepertion of indigenous oil in the total consumption. With the world oil markets being highly conscious of its intrinsic value - to wit "oil in the ground is more valuable than oil taken out" - there does not appear to be any prospects of obtaining cheap oil from abroad. The policy has therefore to be to limit oil consumption to unavoidable uses such as transport, chemical industries etc. Even then it is estimated by Fuel Policy Committee that oil will constitute almost 50% of the total energy consumption in the future, The extent to which this the energy sector and of this about 5.8 mt as HSDO and FO and 2.5 mt as kerosene, In terms of coal replacement value their relative properties will be as follows :

HSDO for transport	52.2.mter	55%
Motor gas	12.0 "	12%
	64.2	67%
F.O.	11.2 "	11%
Kerosene	20.75 "	22%
	96.15	100%

While it is possible to decrease railway's consumption of HSDO by greater use of electricity for railway traction, it is difficult to conceive an alternative energy which can substantially replace the energy for road transport within the next 25 years. Even if the fuel cell graduates into commercial use, it will only help to increase the efficiency of use of oil. Electric storage batteries used for road vehicle traction may become practicab but may not become so cheap as to displace the existing vehicles. The use of kerosene which is used mainly for lighting may go down substantially with increasing rural electrification as well as biogas utilisation. With all these substitutions, it is doubtful if the share of oil in the total commercial energy picture in the 2000's can be reduced below about 20%. The Fuel Policy Committee envisages a 42% share by 1990. In view of the high multiplying factor of oil products for conversion to coal replacement, even a modest reduction in oil consumption will have a magnified effect in reduction of its share in total energy.

Nuclear Energy :

The rate of increase of nuclear power in India has been very low and a meagre 500 MW has been commissioned so far. The nuclear programme of the Department of Atomic Energy is to have 1900 MW by 1983-84 and 8600 MW by 1990. A figure of 5 MKW by 1990 assumed by Fuel Policy Committee may be taken as realistic. The energy output of the present generation of nuclear plant which will perhaps continue upto 1990 is rather low being about 5000 kwh/kw installed. Assuming a level of 6000 kwh/kw to be reached in the future the total energy output from nuclear plants will be 30 Twh by 1990. The growth of nuclear energy cannot be unduly stimulated until the breeder technology is perfected, keeping in view out limited uranium resources. But in view of our large Thorium deposits, our nuclear generation programme will receive a fillip with the development of breeder technology for using thorium. Hence a faster development of nuclear power can be assumed after 1990, by which time it is expected that the breeder technology will have been commercialised. We may therefore expect a contribution of about 150 Twh, i.e. 150 mter of nuclear energy by 2001.

While these projections seem to be within the realm of feasibility, and fit in with out sub-scenario a1, meeting the objective of the scenario a2 viz. raising the per capita consumption to 3 tcr by 2001, will not only involve considerable stepping up of out indigenous energy development, but also enormous amounts of import of energy - presumably in the form of oil - The broad energy balance for the year 2001 that emerges as a result of these projections is as follows :

	a1	a2
Total demand mtcr	1500	3000
Non-commercial energy	235	235
Commercial energy		
Hydro-electric	250	250
Thermal Power	450	600
Nuclear	150	300
Coal (direct or gasified)	225	300
Oil products	200	1325
	1500	3000

The vision for the year 2001 can be summarised as follows so far as scenario a1 is concerned. Although the number of Indians will have multiplied to a staggering figure of 960 million, the average citizen will be enjoying more energy - about 1.5 tcr compared to his (1970) consumption of 0.687 tcr. The average rural inhabitant will also have increased energy consumption by 55% thanks to biogas which adds 0.2 kg.cr to his energy consumption, although he refrains from resorting to indiscriminate felling of trees for fuel and sets apart 50% of the agricultural and forest waste for manure production. He will have got accustomed to proper collection and utilisation of animal dung (without spending extra energy) for production of biogas. This will have brought about considerable cleanliness in the village and reduction of flies, mosquitoes and hence disease and pestilence. He will be enjoying clean gaseous fuel for his or her (one cannot be sure) cooking and utilising solar energy for accelerating biogas production and also for drying agricultural products, and possibly for meeting domestic requirement of the hot water and homes. He will have dispensed with kerosene lamps and will be using either electric lights or gas light. He will still tend to his bullocks, cows and buffalows, and even donkeys whose utility will have been enhanced by adopting improved breeds and care for their health. He may use electricity or gas for pumping water and may enjoy public protected water supply. Electric pumps for agricultural purposes will be almost universal. He will still be using his bullock cart for transporting his implements and men to his farm and back and his produce to the nearest railhead or commercial town. This he will find more economical than using a diesel driven truck. He will have probably fitted pneumatic tyres to his cart with efficient bearings so that he can transport more goods with the same pair of bullocks and men with more comfort. Due to high cost of oil tractors will have limited use unless they are converted to biogas.

He will have his individual radio receiver and may join the community to watch the T.V. He and his family will have to reduce road travel for longer distances than can be managed by his bullock cart, as that will be expensive. The bulk of his additional energy consumption will be derived by adoption of improved processes, and more efficient use of the energy. Some of the tiresome chores like grinding of corn, chopping of fodder, lifting and fetching of water will have been lightened by electricity or gas.

The urban dweller, will be getting most of his domestic energy requirements either from electricity or gas or brickets and the inefficient sigri or chulla will have been replaced by gas burner or smokeless bricket burning stoves, designed for more efficient use of fuel. Approximately half of the domestic energy consumption will be in the form of electricity and the balance in the form of coke, coal gas, brickets, etc. The high hydrocarbon fuel costs will have reduced personal motor transport. Mass transit systems like trains, using oil product driven buses or even electric trolley buses would be the order of the day. Battery driven buses or cars might have made a debut. Air-conditioning of buildings using solar energy during the day would have gained ground although it is doubtful if solar energy for cooking purposes would have made much headway. The development of the solar cell of adequate capacity with storage battery supplying energy requirement of each building will perhaps be nearing fruition. The present method of central power generation and distribution will still be in vogue. Coal-based gas supply by pipeline network may have gained popularity for supplying domestic heat in urban centres. Biogas generated from city sullage will be meeting a part of the urban energy needs.

The Railways will be utilising electric traction on all the high density sections and will be catering to the bulk of the long-distance transport of men and materials. Well-integrated power grids with pit-head super thermal stations and super hydel stations at all possible locations will ensure reliable supply to railways. Revolutionary developments in inter-communication systems will help to reduce business travel as well as travel for social purposes, teleprinter, telewriting, and T.V. telephones etc. may help counduct business without having recourse to meetings across the table. The meetings may well be across the tele-links with T.V. and telewriting for authentication, recording of discussions etc. For social contacts the T.V. telephone may partly offset the need for expensive local travel. People will thus tend to live in small communities, even in large towns. Development of community centres will therefore be of prime importance, as a basic social pre-requisite.

Energy processes causing atmospheric pollution will have been either removed or modified. This will place greater and greater demands on electricity and on processed fuel in the form of brickets since oil products will have to be conserved. Diesel oil driven transport system will have switched over to petrol to reduce air pollution. Individual light bicycle or moped type transport powered by electricity from storage battery may become popular and may supplant the present private transport systems. This kind of vehicles are feasible and have been generally popular in India due to its warm climate and this trend may be strengthened.

On the whole it can be said that energy supply will not pose a problem for the year 2001. Although the level of consumption will still continue to be far lower than in advanced

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countries, there will definitely be a shift in favour of electricity due to its being clean and versatile and due to the feasibility of producing it from many kinds of primary energy. Efficiency of conversion of primary energy to electricity will have undergone improvement, enabling its production at economic costs and reducing the rate of exhaustion of primary energy resources.

The difficulties arising out of world oil crises will be overcome by making use of available indigenous resources of primary energy, which with the anticipated development of the breeder reactor in the nineties may last for another century.

Scenario (b)

Since our projections for scenario (a) have revealed that the indigenous energy resources would not impose any constraints in so far as the sub-scenario (a1) is concerned, this scenario could as well fulfil the basic goals of scenario (b). In fact it is evident that the constraints of scenario (b) rule out scenario (a2).

Scenario (c)

While it is very difficult to have a consensus on the basic requirements conducive to human happiness based on a philosophical attitude of mind, the approach for painting a scenario on these bases can be as follows :

I. Set down the basic human requirements in terms of food, housing, clothing, transport, recreation, education, cultural activities, etc.

II. Work out the energy requirements for providing the above basic requirements including extraction of raw materials, transport, manufacture and distribution of the basic requirements.

Contd.....83

In order to set the basic needs as specified in I above, the combined efforts of the Committees working on other Sectors of Futurology would be necessary if it is possible to arrive at a consensus about the set of these basic requirements, then the second step can easily be taken.

FOOD

A DELPHIC STUDY ON SOLUTIONS TO FOOD PROBLEM IN INDIA

By

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ABSTRACT:

Eighty events were assessed in a Delphic study on future solutions to food problem in India. Increasing the area of irrigated land to fifty million hectares (likely by 1992) will have the maximum impact. Increase in non-wheat bread, double cropping, plant protein yield, fish production and decrease in post harvest losses are the other major important solutions. Four alternate scenarios, consisting of various combinations of possible solutions, for the food supply in India in the year 2000 are presented.

INTRODUCTION:

Delphi was developed by N. Dalkey and O. Helmer[1] as a technique for arriving at the probable future using a sequence of questionnaires sent to experts in the area. This technique has been used in a wide variety of fields, in many countries with and without modifications of the original technique 2-27 proposed by N. Dalkey and O. Helmer. Most of the Delphic studies, however, have been done in the Western Countries and they may not be directly applicable in developing countries, like India. The levels of technologies, resources, social structure and economic environment in a developing country like India is very different and we feel that the experts working in India are likely to have a unique view point on the future solutions. In India studies of the future using Delphi technique have not been reported so far. One of the major problem areas of importance in India is food for the growing population. Therefore, this Delphi was conducted in Indian environment on future solutions to food problems. Much of what will happen on the food front in India in future will be a result of the mental processes of the persons working in India.

The objective of this study is to forecast the possible solutions to the Indian food problem in future, relative impacts of the various solutions have also been

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determined in this Delphi study. These forecasts could form part of a detailed planning exercise for the planners, decision makers, entrepreneurs and research scientists in resource allocation and project selection. The study focuses on the solutions to hunger and malnutrition in India, through the use of basic or processed foods which are acceptable to the consumers in India. In certain instances the results of the Indian Delphic study are compared with other Delphi forecasts done by various agencies in other countries.

METHODOLOGY:

A modified Delphi similar to SEER[28] (system for Event Evaluation and Review) was used in the present study as a basis for deriving a list of forecasts. The questions that were asked in the Delphi study were derived from three sources. (1) The questions that were already asked in Delphi studies run in other countries, in areas related to food, Some of these events and their years of likely occurrences asderived by the respective agencies in other countries are listed in Table 1. (2) Judgments of the authors of this paper on the food problems. (3) The events suggested by the panelists in the first round which were included in the second round questionnaire.

A questionnaire containing developments in the following general areas given below were prepared:

(1) Bread and baking industry (Table 2)
(2) Fish and fish processing (Table 3)
(3) Agriculture (Table 4)
and (4) Unconventional foods (Table 5)

The questionnaire was mailed to 143 scientists and experts in food and related disciplines. The overall distribution of the panelists by their affiliations and their responses to questionnaires are given in Table 5A. Any individual question in the first round was responded to by atleast fifteen panelists. The participants were asked to anticipate the likely year (more than 50 per cent probability) of the occurrence of the events listed by us; in addition they were asked to indicate the impact of the events in terms of major, minor or nil. The impact of the event if occurred was quantified by giving 2, 1 and 0 as scores for major, minor or nil impacts. The panelists were also asked to suggest events, other than those mentioned in the questionnaire which may have large impacts. In all 31 additional events were suggested by the panelists in the first round questionnaire.

The responses from the first round of questionnaire were analysed and feed back to the participants along with the second round of questionnaire. In the second round the panelists were asked to review the group response given to them as the average of the answers of round one, and modify their previous response, if they so desired. They were also required to explicitly express reasons, if any, for being over optimistic or pessimistic compared to the group average. The results of the whole Delphic exercise are presented in tables 2 to 5.

In addition to the expected date of occurrence of the event, inter quartile range (middle 50 per cent) has been calculated and tabulated. The impact score of the group is given in terms of the average value (2 = major, 1 = minor and 0 = nil). The second round average response and the reasons for being pessimistic or optimistic compared to the group average are also represented in tables 2, 3, 4 and 5 in column 7. In the following discussion the medians of the response from the second round of questionnaire are used as a basis for discussion.

RESULTS AND DISCUSSIONS:

A. Bread and Baking Industry:

The baking industry in India is growing fairly rapidly. Most of this industry is in the form of Small Scale Industries (Total investment less than $ 2,33,000 or £ 55,555) only about 2% is in the form of medium or large scale industry. The large scale bakeries produce 41% of the total bread in India. Shortage of wheat and the poor baking quality of Indian wheat are the major constraints in the growth of this industry. According to the Delphi study, large scale use of non-wheat flours like topioca and millet for bread making would occur by 1986 and this will have a major impact in India (2.0). The technology of baking non-wheat flours is available and the shortage of wheat flour in our bakeries would serve as an incentive for substitution. Fortification of bread with soya bean flour (upto 25% of total bread production) is likely to occur by 1981 since the technology is simple and is already available in India. Development of effective chemical preservatives to increase the keeping quality of bread to about one month is likely to ccur by 1983. Modernisation of small bakeries (by 1983) would help the baking industry. Commercial production and marketing Indian forms of bread (nan, chapathi and paratha) with possibly long shelf lives may occur by 1980, since increasing employment of women would increase the demand for such convenience foods.

B. Fish and Marine Products Industry:

Presently the total fish catch is about 2 million tonnes. Conventional fish processing techniques presently practised in India include salting, sun drying, canning and refrigeration. Freezing and cold storage still find only limited use. Fish products have a lot of potential for meeting the protein gap as well as for increasing export earnings. According to the Delphi study, the total fish catch could reach a value of 4 million tonnes by 1988 with the present state of technology; this event will have maximum impact on India (1.81) among the options in this section. However, this target could be reached earlier by intensive fish farming in inland lakes, ponds, paddy fields, as well as by using more powerful trawlers (already available) for deep sea fishing, improved fish catching and locating techniques, and the use of mechanised fishing craft. Efficient and cheap preservation by refrigeration and refrigerated transport is more likely to occur as compared to preservation by irradiation or antibiotics (these latter options have toxicological objections). Efficient utilisation of fish processing wastes and by-products for production of fish oil and fish protein concentrate should be accelerated by suitable inputs in order that it occurs before 1983, because of the urgency of the need for good quality proteins. However, there is an overall feeling amongst the panelists that the use of fish and its products will remain limited since India's population is predominantly vegetarian.

C. Agriculture:

In 1972, a total food grain production of 108 million tonnes was reported, out of which 11.06 million tonnes was pulses. The agricultural methods used are still conventional, with the farm holdings being small. Only about 30 million hectares (1971) of land is irrigated and 25 million hectares are under double cropping out of the total cropped area of 160 million hectares. Total irrigated land is likely to become 50 million hectares by 1992 and this event will have maximum impact (1.95) among all the alternative options listed in this Delphi. This is linked with better techniques of water management and availability.

The fertilizer consumption per hectare is extremely low (16 kilogrammes per hectare of cropped area) as compared to other countries (Japan = 150 Kg per hectare). Since the fertilizer production is far less compared to the demand (out of the total consumption of 16,52,000 tonnes of nitrogen fertilizer used, 4,81,000 tonnes were imported in 1972), organic manures and natural manures will be increasingly used. By 1988 fertilizer consumption per hectare will reach

50 Kg. if the present petroleum crisis is overcome. This event also will have a major impact (1.75) on Indian agriculture. Better utilisation of human excreta, cowdung (avoiding burning of cowdung for energy and instead installing gobar gas plants) and other organic wastes is also envisioned by 1985.

Harvesting, milling and storage techniques are still very crude and conventional, leading to large losses (20 to 25%). These losses will be reduced to 5% by 1998 and this event will have a high impact (score 1.92). Reduction in post harvest and storage losses to 10 per cent by 1986 or earlier is possible with considerable inputs. According to the panelists, total food grain production of 141 million tonnes can be achieved by 1982 (predicted minimum requiremet of food grain in 1982 is estimated to be in excess of 142 million tonnes). Out of this 142 million tonnes, the requirement of pulses is 25 million tonnes which will not be satisfied by 1982. Panelists predict this level of production of pulses by 1988. The production of pulses has not increased since 1961. Development of new strains of cereals and pulses capable of achieving higher yield, and better protein content is likely to be achieved, and will be in common use for cultivation by 1992. The impact of this event also will be large (score 1.86).

The panelists do not think that unconventional methods of farming would contribute substantially to the total food production before 2000 or ever at all. Agriculture at sea, multilayer farming or hydroponics are considered as impossible within this century in India; the impact score of all these are around 1.2. The panelists are of the view that these methods could not become economical in India as compared to the agricultural resources available today. Control of pests or pathogens by biological, chemical or genetic means come under 2000 or never events; though the impact score is as high as 1.75.

D. Unconventional Foods:

In this area the panel members are not optimistic about any significant occurrence before the 1990's. Several events in this section of the questionnaire (Table 5) are assigned to the 2000 or never category. In the 1990's they envision the use of yeast, leaf and grass protein, cellulose, algae, bacteria, fungi and vegetarian meat on a large scale. The impact of algae production is highest among the unconventional foods. The panel members felt that

(i) food production will have to be a regenerative system

(ii) Organoleptic contentment is important for food and will have to be provided for

(iii) Economic feasibility of a process as compared to the conventional resources require extensive studies and

(iv) Acceptability for new type of foods have to be achieved through extensive nutrition education and community feeding.

COMPARISON OF FORECASTS IN OTHER COUNTRIES WITH THE INDIAN FORECASTS:

The forecasts made in the present Delphi exercise reflect the resource position, existing state of technology, man power availability, cultural and social attitudes and economic structure of India. Delphi exercises performed in different countries yield different results depending on the respective environments. Table 6 gives a comparison of the dates of occurrence of similar events derived from Delphi exercises performed in India and USA. The occurrence of the events in India are predicted to be at considerably later dates as compared to the forecasts in USA.

SCENARIOS FOR THE YEAR 2000:

Four alternate scenarios based on the various combinations of the possible solutions to the food problem have been presented in Table 7. The detailed fine maps outlining research and production inputs required, and the relative economic and resource considerations of these alternate scenarios will be discussed in a subsequent paper.

CONCLUSIONS:

(1) Results of a Delphi study on future solutions to food problem in India, involving the assessment of eighty events, are reported. The likely dates of occurrence of certain events, arrived through this Delphi study (conducted in India), are considerably later than the dates for the same events determined through Delphic studies performed in other countries.

(2) The seven events with the greatest impact (on a scale 0 to 2) and their likely dates of occurrence (50% probability) are the following:

	Event	Impact	Year of Occurrence
i)	Irrigated land will be 50 million hectare	1.95	1992
ii)	Reducing post harvest and storage losses to 5%	1.92	1998
iii)	Strains of plants with higher yield and protein content	1.86	1991
iv)	Area under double cropping will be 50 million hectares	1.85	1993
v)	Synthetic gluten will be manufactured	1.82	1992
vi)	Fish catch will be 4 million tonnes	1.81	1988
vii)	Use of non-wheat flours for bread	-	1986

(3) Three events not likely to occur by the year 2000, but have relatively large impacts are as follows:

	Event	Impact	Year of Occurrence
i)	Complete control of plant pathogens	1.75	2012 - Never
ii)	Complete biological control of pests	1.67	2000 - Never
iii)	Complete nutritional requirements through one pill per day	1.55	Never

(4) Algae, leaf protein, yeast, fungi and vegetarian meat are the other important events for the 1990's.

(5) For alternate scenarios the food production in India in the year 2000 have been presented using different combinations of the possible solutions.

TABLE 1

(Typical Delhi Results of Importance in the Area of Food Derived by Various Agencies in Developed Countries)

	Event	Likely year of occurrence
1.	Half of all meat will be bred and grown in animal hotels on accelerated maturity cycles.	1985-88
2.	Petrochemical protein as synthesised food for human consumption.	1980-85
3.	Significant contribution of microbial system to world food supplies	1985-2000
4.	25% of meat and meat products will be replaced by new protein sources in a meat like form (UK).	1982-2010
5.	Development of new food sources such as algae, plankton etc. will be grown in artificial environment.	1979
6.	Mariculture will be the source of at least twice as much sea-food as at present.	1980-85
7.	Exploitation of the ocean through farming producing 20% of world's food	2000-2017
8.	Techniques which can increase the world's arable acrage by 50%.	1987-1997
9.	Economically improving calorie productivity per acre by factors of 10 by genetic techniques.	2000-2005
10.	Economic feasibility of commercial generation of synthetic protein for food.	1985-2003

TABLE 2

DELPHI STUDY IN THE AREA OF FUTURE OF "BREAD AND BAKING INDUSTRY"

Event	(0 - 2) Impact	Average of first Round	Second Round	Inter quartile Range	ARGUMENTS FOR		
					Earlier Occurrence	Later Occurrence	Never
1	2	3	4	5	6	7	8
Use of techniques such as dielectric and ultrasonics for improving shelf life of bread.	1.00	1987	1988	1985-2000		Cheap technology and surplus food will not be achieved before 2000.	Technology not attractive. As per present concept this can never happen.
Use of nuclear irradiation to improve shelf life of bread.	1.23	1982	1985	1980-1990	Advanced research is being done in India.	Simpler methods may be availed. Toxicological objections are yet to be overcome.	Chemical preservatives and packing will serve the purpose.
Development and use of newer, better and more effective preservation agents, other than the presently use calcium propionate.	1.55	1983	1983	1980-1990	Due to fast growth of bakeries and mass distribution, world-wide R&D efforts are in progress.		

1	2	3	4	5	6	7	8
Soyabean fortification of bread upto						Availability of soyabean	Soyabean production will not be sufficient to fortify 75% of the bread production
75% of the total bread production	1.63	1989	1991	1990-2000		Consumer acceptance of changes in texture and taste	
50% of the total bread production	1.55	1935	1986	1985-1991			
25% of the total bread production	1.53	1981	1981	1980-1985			
Other unconventional high protein sources will be used for the bread fortification in an appreciable quantity:-					Algae protein technology is simpler than that of leaf, so it could be commercialised earlier	Acceptability will delay commercialisation of FPC Lack of raw materials will delay SCP	Incompatibility of leaf protein with known foods. Leaf protein and FPC will not be used for bread fortification
Cottonseed protein	1.47	1984	1984	1980-1985			
Leaf protein	1.40	1990	1992	1985-2000			
Synthetic single cell protein(SCP)	1.18	1995	1994	1985-2000			
Algae powder	1.33	1998	1997	1990-2000			
Fish protein	1.25	1986	1986	1980-1990			

1	2	3	4	5	6	78	8
Other source suggested by panelists:							
Sunflower protein		1985	1985	1983-1985			
Commercial production of synthetic gluten for bread making.	1.82	1991	1992	1990-2000		Synthesis of the protein is yet to be achieved.	
Other events of possible large impact on Indian bread industry as suggested by panelists:		1988	1986	1985-1988	Technologically feasible even now. Difficulty in availability of wheat flour to bakeries	Lot of prejudice in India for new food acceptance	
Large scale use of non-wheat flours such as tapicca, millet etc. in bread making.							
Preservation of bread for more than a month		1990	1989	1980-1990			
Introduction of continuous and automatic bread making plants		1993	1992	1990-1993	Due to necessity Already existing in other countries		
Modernisation of small and medium sized bakeries		1980	1983	1980-1990	Already in Progress	Resource Availability	
Making of Indian forms of bread in bakeries		1980	1980	1976-1985			

1	2	3	4	5	6	7	8
Use of dairy products in bakeries		1980	1983	1982-1990			Expensive proposition
Frozen doughs		1985	1991	1990-2000		Cheap freezing methods not available now	
Small sized yeast plant (100-150 Kg.) compressed yeast/day) sufficient for one bakery unit will be economical.		1985	1983	1978-1985	Technologically feasible Due to the need of making bakeries less dependent on outside market.		

DELPHI STUDY IN THE AREA OF FUTURE ON INDIAN FISH AND OTHER MARINE PRODUCTS

INDUSTRY

Event	Impact	Round I	Round II	IQR	Early	Later	Never
1	2	3	4	5	6	7	8
Total fish catch will reach a value of 4 m. tonnes with the present state of technology (1965 = 1.142 M.T. 1971 = 1.845 M.T.)	1.81	1988	1988	1985-2000			
Efficient and cheap fish preservation and transportation techniques such as following (suggested by panelists) will be used:-							
Refrigeration and refrigerated transport	1.43	1985	1985	1982-1985			
Irradiation	1.57	1984	1985	1983-1985		Toxicological objections. First meat irradiation has to be allowed.	
Antibiotic	1.38	1982	1986	1980-2000			
Utilization of the principles of selective breeding, so that only superior species of fish capable of providing more efficient protein conversion will be used.					Due to high desirability		

1	2	3	4	5	6	7	8
Wide spread practice of fish farming in artificial or natural lakes or paddy fields to produce at least:-						Lack of water and suitable nutrients Lack of efforts	
5% of the total production	1.57	1986	1986	1985-1990			
10% of the total production	1.62	1995	1996	1990-2000			
Possibility of developing harmones or any other chemical agents to provide faster fish growth (e.g. pituitary harmones, cobalt chloride etc.)	1.64	1991	1992	1990-2000		Restraint from medical side Slow rate of research utilization in India.	
Development of efficient and cheap deodourisation or fish powder.	1.47	1982	1982	1980-1985		Predominantly vegetarian population will delay commercialization.	
Possibility of reducing fish processing losses to:-							
10%	1.38	1985	1985	1980-1990			
5%	1.33	1988	1989	1980-1990			
and utilization of wastes efficiently							

1	2	3	4	5	6	7	8
Other events of possible large impact on Indian fish and Marine products Industry, as suggested by panelists:-							
Development of cheap freeze drying method for fish		2000	2000	2000		It will not be economical in the near future	
Deep sea fishing		1985	1984	1980-1985	Powerful trawlers already available.		
Separation of bone free edible meat from trash fish		2000	1996	1990-2000			
Canning of oil sardine and Mackerel during gluts		2000	1990	1980-2000			
Isolation of insulin from fish pancreas		1975	1979	1975-1980			
Improved locating and catching techniques and more mechanised fishing craft.		1990	1989	1985-1990	Higher funds allocated by Government.	Limited resource availability.	
More efficient bye-product utilization		1980	1983	1980-1985			

TABLE 4

DELPHIC STUDY OF FUTURE OF INDIAN AGRICULTURE

(M.T. = Million tonnes, M.H. = Million Hectares, G.T. = Greater than)

Event	Impact	Round I	Round II	IQR	Early	Later	Never
1	2	3	4	5	6	7	8
Possibility of achieving a total food grain production of 141 M.T. (1954 = 66 M.T. 1959 = 73.5 M.T. 1964 = 79.4 M.T. 1971 = 115 M.T. 1972 = 108 M.T.)	1.43	1982	1982	1980-1985	Possible earlier if we plan and develop our agriculture right now		
Possibility of achieving the minimum nutritional requirement of 25 M.T. of pulses (1961 = 11.11 M.T. 1965 = 10.88 M.T. 1966 = 8.76 M.T. 1970 = 11.69 M.T. 1972 = 11.06 M.T.)	1.5	1988	1988	1985-2000	Due to premium prices on pulses		
Development of new strains of plants providing:					Due to efforts being made, breakthrough is possible earlier.	Once higher production is achieved emphasis on protein will reduce, so efforts will be more for higher yield.	
Higher protein content	1.47	1986	1986	1984-1990			
Higher yield	1.69	1981	1981	1980-1990	Already some strains developed		
Better nutritional quality protein	1.66	1989	1989	1985-2000			
High yield and higher	1.86	1992	1991	1985-			

1	2	3	4	5	6	7	8
Agriculture at sea							
Infloating platforms	1.33	2012-Never	Never	2000-Never			Not economical in India compared to other available methods.
In the form of algae and plankton	1.42	200	2004	2000-2085			
Weeds	1.33	1999	1999	1990-2000			English agricultural resources available and hence not much pressure to go for these systems.
Whale farming	1.00	Never	Never	2000-Never			
Multilayer farming or 3-dimensional farming	1.3	2035-Never	Never	2000-Never			
Utilizing hydroponic techniques (soil-less cultivation or on sand by feeding nutrients in water):-							
1 M.T. of food	1.36	2005-Never	2005-Never	2005-Never			
5 M.T. of food	1.54	2030-Never	2030-Never	2030-Never			
Total irrigated land will become 50 million hectares (1951 = 20 M.H. 1967 = 27.5 M.H. 1971 = 30 M.H.)	1.95	1998	1992	1984-2000	Present area irrigated = 35 M.H. growing @ 3%. Intensive efforts made by Govt.	All resources are available failures are only due to human causes	Need to reduce population and increase forests.

1	2	3	4	5	6	7	8
Total area under double cropping will become 50 M.H. (1971) = 25 M.H.)	1.85	1991	1993	1980- 2000		At any time area irrigated is area under double cropping.	
Consumption of fertilizer per hectare of cropped area will be:						Slight set back initially due to petrol crisis.	
India							
1952 = 0.5 Kg 1960 = 1.9 Kg 20 Kg	1.62	1978	1978	1976- 1980		Due to snags in production, higher consumption will be delayed.	
1965 = 5.0 Kg 50 Kg 1970 = 14.0 Kg	1.75	1988	1988	1985- 1990			
1971 = 16.0 Kg 75 Kg (Japan = 150 Kg.)	1.75	2003	2003	1995- 2025			
Development of techniques which can increase India's arable acrage by 50% without prohibitive cost (economic arable and desert farming).	1.86	1996	1996	1985- 2000			
Complete biological control of pests through their natural enemies	1.67	2000 Never	2000 Never	2000 Never	Possible earlier, if R&D efforts are intensified		
reducing post-harvest losses, including losses during storage to:- 10%	1.82	1986	1986	1985-			

1	2	3	4	5	6	7	8
(Presently 20-25%) 5%	1.92	1998	1998	1985-2000			
Complete control over plant pathogens by bio-chemical and genetic methods.	1.75	2012	2012			Development of resistant strains and new chemicals may accomplish it, but at a later date.	Not a practical and economical preposition.
Other events of possible large impact on Indian agriculture, as suggested by panelists:-							
Farm management and development of agriculture as Joint Stock Co.		2000	2000	2000 Never	Food shortage will have no other alternative.		Land policy and ceiling on land holdings.
Development of water storage reservoirs, North-South canal and National Water Grid		1985	1991	1985-2000		Poor resource position. Survey of Ganga-Cauvery link not yet initiated.	
Better utilization of human excreta, cowdung and other organic manures.		1980	1985	1980-1985			
Scientific approach by majority of agriculturists.		2000	Before 2000				

1	2	3	4	5	6	7	8
Promotion of efficiency in agriculture.		2000	Before 2000				
Development of dairy industry and achieving 40 M.T. of milk/year		1990	1992	1990-1995			
Heat treatment and periodic supply of essential micro-nutrients to the soil.		1975	1980	1980-		Widespread and appreciable use will take time.	
Utilisation of all available land.		1980	1992	1980-1995		Long time in developing areas with no water supply.	

A DELPHIC STUDY OF FUTURE IN UNCONVENTIONAL FOODS PROCESSING IN INDIA

Event 1	Impact 2	Round I 3	Round II 4	IQR 5	Earlier 6	Later 7	Never 8
Fermentative production of food yeast from n-paraffins for human consumption in a commercial way.	1.11	1990	1990	1985-2000			Foods will have to be a regenerative system, Petroleum will be used for chemicals Petrol crisis
Economic production of protein from coal in a commercial way	1.0	2013 Never	2015 Never	2000 Never	Due to advances made	Coal has to be gasified before protein conversion by microbes	
Economic production of protein for human consumption from leaves, grass sea-weeds and waste vegetable matter will be possible	1.44	1992	1992	1990-2000		Removal of silica from grass will be uneconomical	It will not be economical ss inforced by large scale efforts. Organoleptic objections.
Faster animal growth cycles will be achieved using chemical, genetic or radiational techniques	1.39	2000	2000	1995-2000			
Cellulose will be used for production of consumable proteins, commercially	1.48	1992	1992	1990-2000	This will give better protein than leaf protein.	First yeast, algae etc. has to be accepted	Cellulose has much better use
Algae fit for human consumption will be produced in:							
Factories	1.07	2006	2001	2000-2020	Technology has been already developed.		

1	2	3	4	5	6	7	8
Development of alternate sources of sugar		2000	1994	1990-2000			
Development of technology for preparing textured vegetable protein products (vegetarian meat) to exploit poorly utilized sources.		1985	1986	1985-2000			
Use of reptiles, insects and animal blood as protein source		2000	Never	2000-Never			
Availability of water, fertilizer, and seeds synchronously		2000	1993	1985-2000			
Nitrogen fixation in soil		2000	1993	1980-2000			
Making available phosphorous from phytin		2000	1993	1980-2000			

1	2	3	4	5	6	7	8
Concentrated energy pills liberating controlled amounts of chemical energy (2420 calories/day) by metabolic activity, for human consumption will be available.	1.44	Never	Never	2010-Never			Organole contentm very imp
Unconventional microbial system of food supplies will be significant mainly from:							
Bacteria	1.40	1998	1998	1990-2050			
Yeast	1.45	1993	1993	1990-2000	Already recognised		
Fungi	1.40	1994	1994	1994	Already recognised		
Algae	1.56	1993	1994	1990-2000			
Other events of possible large impact on unconventional food production, as suggested by panelists:-							
Development of minor oil seeds		1990	1990	1980-1995			
Use of microbes for fat production		2000	1996	1980-2000			

TABLE - 5A Response to Delphi

Category of experts	First round questionnaires mailed to	Total responded to first round	Total participated	% participated	Total participated (2 round questionnaire)	% participated to the II round
1. Scientists in universities and research scientists	84	44	31	36.9	18	58
2. Scientists and experts in industry	39	7	5	12.8	3	60
3. Experts in Govt. ministries and offices	13	4	2	15.4	2	100
4. Others	7	2	1	14.3	-	-
Total	143	57	39	27.3	23	50

Total participated differ from total responded since a number of people indicated that they did not have the necessary expertise to answer the questionnaire.

FOUR ALTERNATE SCENARIOS FOR FOOD PRODUCTION IN INDIA IN THE YEAR 2000

	IRRIGATION	FERTILIZER	FISH	UNCONVENTIONAL FOODS	PROBABLE PROCESSED FOODS
Scenario I	60 million hectares (possibly through dams, canals, desalination, and solar pumps).	35 Kgs. per hectare of cropped area	4 million tonnes (fish also grown in paddy fields)	Very small (less) than 0.1 million tonnes)	Wheat products fortified with soyabean, peanut and cotton seed flour. Indian forms of bread (nan, chappati, paratha with long shelf life. Processed fish.
Scenario II	40 million hectares (possibly through reduced water requirement by dry farming & coating polymers on leaves.	70 Kgs per hectare of cropped area (possibly through six coal based fertilizer units and modernized farm management	3 million tonnes (fish meal used as fertilizer).	Very small (less than 0.1 million tonnes)	Wheat products fortified with soyabean, peanut and cotton seed flour. Indian forms of bread with long shelf life.
Scenario III	40 million hectares	35 Kgs per hectare of cropped area	10 million tonnes of fish(By improved catching, transportation, processing, deep sea fishing. Fish products find wide acceptance)	10 million tonnes of sea weeds, algal single cell protein are produced	Completely odor less and refined fish protein concentrate vegetarian meat preparations
Scenario IV	40 million hectares	35 Kgs per hectare of cropped area	4 million tonnes	20 million tonnes of algae, sea weeds, single cell protein. Leaf protein produced	Vegetarian meat products. Synthetic milk from leaves. Algae, single cell protein and sea weed fortified bread

TABLE 6

Comparison of Forecasts

Forecast	Country in which Delphi performed	Date of occurrence
Petrochemical protein as synthesised food for human consumption will be a significant market by the year	USA	1980-85
Fermentation production of food yeast from paraffins for human consumption in a commercial way	India	1990
Development of techniques which can increase the worlds arable acrage by 50% without prohibitive cost penalties	USA	1987-1997
Development of techniques which can increase India's arable acrage by 50% without prohibitive cost	India	1996
Development of new food sources such as algae, plankton etc. which are grown in artificial environment	USA	1979
Algae for human food grown in lakes, ponds or/and controlled environments	India	1991

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THE FOOD SCENARIO - AN EXERCISE

by

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The need to quantify the demand for and supply of foodgrains for many years to come arises from the fact that the allocation of resources would pose many problems unless the priorities are put in order. Futuristic calculations are by and large speculative but a good measure of predictive value could be imparted to them by bringing them closer to the functioning of actual variables in reality. For this it has been assumed that there is a logical continuity in the process and events in time and space. In other words the probability of topsyturvy events occurring in the world is assumed to be at the minimum. Therefore, it is not difficult to appreciate that the futuristic determinism has no value unless prediction is set within the co-ordinates of human will and correct policy.

The world organisations, especially Food and Agricultural Organisation (FAO) has faced with the grim prospect of feeding the world population - present and future. Various experts world over are busy estimating the demand for (as represented by the growth of population and per capita GDP upto the end of the century) and supply of (indicated by the availability of all foods - cereals, meat, milk, sea food etc.) food for satisfying human hunger and other commodities for allowing a minimum standard of living. Preparing projections of population GDP, food grains and other foods is beset with umpteen difficulties because of the varied degrees of economic, social, cultural and educational progress. However, the FAO has assessed the world food situation for the following two decades.

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The principle components in the process are the population and income growth. Relative prices are, however, assured to remain unchanged. Likewise no change in national, economic or social policies have been taken into account. The methodology generally followed for projecting population or incomes are based on "trend assumption" i.e. assuming that past trends will continue in the future with marginal variations. The alternate growth rates for projecting population or incomes are based on targets established by the U.N. and its regional commissions for the second UN development decade. While the trend alternative reflects actual recent achievements "high alternative" reflects the probable maximum rate of growth which could be foreseen by the U.N.

As per the assumptions the fertility rate on the basis of "low assumptions" was worked out to be 1.8 per cent and on the basis of "high assumptions" 2.1 per cent from 1970 to 1985. On the basis of medium assumptions, the growth rate of world population during the two decades ending 1990 were worked out to 2 per cent per annum compound; while the annual compound growth rate of the developed countries (including Eastern European and USSR) during the following two decades has been estimated at 0.9 per cent, for the developing countries it has been put at 2.4 per cent.

The world food demand in the seventies and eighties is calculated to grow at a rate of 2.4 per cent per annum - of which 2 per cent represents population growth and 0.4 per cent increased purchasing power. However, there are major differences in the country groups - for example, in developed countries, as a group, the growth rate of demand has been estimated at 1.5 per cent per annum as against 3.6 per cent per annum in developing countries in terms of farm value. On the supply side the basis of making projections is of necessity less sure; the only readily available evidence being historical trends which can be extrapolated subject to a variety of assumptions and limitations. On the basis of 1962-1963 to 1973 the production growth rates per annum between 1969-71 and 1985 have been worked out to be 2.4 per cent for developing market economies, 2.6 per cent for developing countries and 3.5 per cent for Eastern Europe and USSR.

On this background of the world projections of demand and supply an attempt has been made to prepare projections upto 2000 A.D. for India.

Though the basic assumptions remain the same, modifications as necessitated by our special environmental conditions have been made wherever necessary.

Population Projections

The growth of population is a function of assumed fertility rates over a period of time. The general fertility rate is the netting of the birth and death rates. As such, any projections of population will depend on the assumed general fertility rate, i.e. net of birth rate and death rate. Before going into the details of the assumptions used for determining the birth and death rates for the period, it may be stated that 3 sets of population projections - high, medium and low - have been prepared on the assumption of the birth rates around 3.0 per cent, 2.5 per cent and 2.0 per cent respectively by 2001.

The estimates of birth and death rates for 1966 to 1970 as estimated by the Sample Registration Scheme (SRS) of the census organisation have been used as the base for future estimates.

It may be stated here that the population trends are influenced by motivated efforts being undertaken for reducing the birth rate. Going by the mechanical trend assumptions the picture would be entirely different and to some extent unrealistic. Annual population growth rate in India during the past two decades, showed a continued uptrend from 1.3 per cent in 1951, 2.1 per cent in 1961 to 2.5 per cent in 1971. Mechanical adherence to the "trend assumption" without smoking any allowance to the "motivated efforts" (family Planning and other) to reduce the birth rate would not be realistic.

A deeper analysis of the birth and death rates would reveal that the population growth during the last two decades has been because of a drastic fall in the death rate - the birth rate, more or less remaining constant (reference Table A).

Table A

(Percentage)

	1951	1961	1971
Birth rate	4.0	4.2	3.9
Death rate	2.7	2.1	1.4
Growth rate	1.3	2.1	2.5

The drastic fall in the death rate has been a direct effect of the various mass health improvement schemes, like anti-malaria, anti-philaria, B.C.G. etc. Likewise the average expectancy of life at birth has increased to around 53 years from a very low of 27 years three decades back. The Government was all along conscious of reducing the birth rate. But the schemes could not yield tangible reasons in a substantial decline in the birth rate. The aim at the beginning of the Fourth Plan was to reduce the birth rate from around 4 per cent in 1968 to 3.2 per cent by the end of the Fourth Plan and to around 2.5 per cent by 1980. According to the Registrar General's sample registration scheme of births and deaths, the birth rates for 1968-69, 1970-71 were constantly around 3.9 per cent for the rural areas. For the urban population, however, the birth rates for 1970 and 1971 were around 3 per cent. Though the lower birth rate in urban areas may not be entirely attributed to the effect of family planning schemes, it is generally observed that the socio-economic structure of the urban areas has been more receptive to the family planning measures to some extent.

The main plank of the Fifth Plan for achieving its objective of removal of poverty and attainment of economic self-reliance has been a drastic reduction in the birth rate. The population is postulated to grow at the rate of 2 per cent during 1971-76, 1.7 per cent during 1976-81 and by 1.4 per cent by 1986. This drastic reduction in population growth rate is to be achieved by a family planning programme. In a way the family planning programme is the back bone or the very base of all the future perspectives and projections of the Fifth Five Year Plan. The Indian Association for the Study of Population (IASP) studied this aspect of population growth not merely as a demographic phenomenon but also as one having varied socio-economic aspects also. Mr. S.Raghavachari while preparing population projections upto 2001 took into account a set of assumptions for determing the future course of mortality based on the expected life expectancy at birth of respective sexes.

The provisional life expectancy for India indicates that the annual increase in the life expectancy at birth during 1961-70 to be 0.50 year and 0.45 year for males and females respectively. These are appreciably less than the optimistic figure of 0.90 year assume or both the sexes in the official projections made in 1968. In the revised official projections brought out in 1971, the annual increase in life expectancy for the decade 1961-70 has been assumed to be 0.50 year for both the sexes. The projections we made are on the basis of these findings. As stated earlier, the projections of population based on the assumptions of the birth, death and general growth rates conform to the UN model. The mortality levels upto 2001 follow linear trend compatible with the quantum of increase in the life expectancy in successive quinquennia with 1966-70 as the base.

For estimates of population as also the demand for foodgrains, the methodology adopted relates to the trend growth rates for each of the items. In the present estimate, we have restricted ourselves to the demand and supply of foodgrains only (rice, wheat, other coarse grains and pulses put together). In estimating the demand for foodgrains, population growth rates have been estimated, assuming high, medium and low trend growth rates, together with a varying quantum of per capita per day consumption levels.

Population Estimates

In the estimates, the trend growth rates of population have been based on demographic trends of birth and death rates as observed during the two decades since 1951. The actual growth rates of population have been increasing during the last 20 years as shown in Table A (Page 3).

It can be seen that the net population growth rate which was 1.3 per cent during the decade 1941-51 increased to 2.1 per cent during 1951-61 and to 2.5 per cent during 1961-71. In working out the growth rates for the future upto 2001 A.D. under the three categories of high, medium and low, allowance has been made for various socio-economic aspects together with the probable success of family planning schemes in varying degrees. The net growth rates so derived have been shown in Table II. The estimates of population using these growth rates are shown in Table III. However, while estimating demand for foodgrains in future, on the basis of different consumption levels, use has been made of the highest level of population estimates.

While using the highest population estimates, growth rate as per our estimates tapers down to 2.1 per cent by 2001 from 2.25 per cent according to demographic estimates in 1971. However, a second population estimate has been specially worked out assuming constant growth rate at 2.25 per cent - that is, assuming complete failure or no effect of any of the population reduction measures. We have given the final estimates of demand and supply for the year 1980-81 and 2000-01. The population estimates for 1981 and 2001 according to (a) tapering growth rate and (b) constant growth rate, are given below:

(Population in crores)

	1971	1981	2001
a)	54.70	67.75	103.21
b)	54.70	68.78	108.37

Food Projections

In estimating the future supply position of total foodgrains available for consumption the method of least square (which is most widely used) has been used. As said earlier in our methodlogy of preparing future estimates of population or demand we have used the trend method. Similarly while projecting the future supplies of foodgrains the trend method has been adopted. It presumes that the growth rate of foodgrains production will project in the future following a given trend. It also presumes no drastic changes in area, methods of cultivation, irrigation, technology, etc. - i.e. no acceleration is involved in this process. However, the normal trend growth whether in technology or in any other improved means of production is reflected in the trend estimates that we have built.

In the method of least square the yearly fluctuations in production are evened out to a straight line which is fitted to data of foodgrains production. For building up the trend growth we have taken the period from 1960-61 to 1973-74; the same trend according to the least square method projects in the future, in this case upto 2001. The equation comes as follows:

$$Pt = 87 + 2.083t$$

Where t = 0 stands for 1966-67

Where t = 1 stands for 1967-68

and Pt stands for foodgrain production in tenth year.

The period from 1960-61 has been taken specifically because it is more significant as it reflects the fruits of various developments schemes during the previous decade of planning. In this sense it is more realistic from the point of view of building up trend growth. As is well known agriculture in India is at the mercy of the vagaries of rains and about 80 per cent of the cultivation depands on rains.

According to the least square method, the production of foodgrains in the year 1981 and 2001 have been estimated as follows:-

	Foodgrains production million tonnes
1981 (gross production)	116.98
Less 12.5 per cent for seed, wastage, etc.	14.62
Net availability	102.36
2001 (gross production)	158.64
Less 12.5 per cent for seed, wastage, etc.	19.83
Net availability	138.81

Demand Projections

Demand for foodgrains is a function of the quantum of foodgrains per head required and the total mouths to be fed. As such, the estimates of demand is a very flexible thing and can vary with the quantity assumed for per capita consumption. Likewise, food requirements vary from person to person depending upon age, social habits, nature of work etc., as also from place to place, especially in a sub-continental country like India. The average calorie requirements, taking into account all the diverse factors, in India has been taken at 2100 per capita per day. Allowing for losses etc. the calorie requirements at retail level are estimated at about 2250 per capita per day.

Now these calorie requirements are derived from the entire diet comprising of foodgrains (cereals and pulses), meat, eggs, milk, fruits, sugar oils etc. In terms of foodgrains, it is estimated that the calorie requirements would be around 1500, which could be obtained from consumption of 500 gms. of foodgrains per capita per day. In all our calculations, we have assumed the same level of consumption for rural and urban areas and for all age groups. Secondly, our assumed quantum of consumption is taken to be constant, not allowing for any change in consumption habits.

Compared to the calorie consumption in developed countries, and taking into consideration the growing per capita income, it is likely that the foodgrains consumption might undergo a change upwards. We have, therefore, made estimates of demand on the basis of 600 grams per capita per day. However, the actual average availability of foodgrains in the country during the years 1961-1974 was around 450 gms. per capita per day. Estimates of demand have been made on this basis also.

In the present public distribution system, the quantum of foodgrains supplied is lower than even the average availability of 450 gms. per capita per day. Recent studies on the public distribution and procurement system have assumed uniform quantum (for rural and urban areas) of 100 Kgs of cereals per head per annum; including pulses, the total requirement of foodgrains is estimated at 140 Kgs per capita per annum, or 385 gms per capita per day. This is the barest minimum required for survival, a quantum which will have to be consumed under any circumstances - rationing or no rationing. Assuming the worst, we have built up demand estimates on the basis of this rock-bottom requirement as well.

In the earlier paragraphs, we have given two sets of population estimates: (a) tapering growth rates and (b) at constant growth rates. The demand projections of foodgrains on the basis of the different requirements for the two sets of population growth estimates would be as under:-

(million tonnes)

I.	@ 600 gms p.c.p.d.			
	(a)	with tapering population growth rate	148.4	226.0
	(b)	with constant population growth rate	151.0	238.0
II.	@ 500 gms p.c.p.d.			
	(a)	"	123.6	188.4
	(b)	"	125.5	197.8
III.	@ 450 gms p.c.p.d.			
	(a)	" "	111.3	169.5
	(b)	" "	113.0	178.0
IV.	@ 385 gms p.c.p.d.			
	(a)	" "	95.2	145.
	(b)	" "	96.7	152.3

We will now juxtapose the demand and supply projections as worked out under different assumptions of foodgrain requirements and see the deficit or surplus of foodgrains in the two landmark years 1981 and 2001. While on the demand side the estimates on the basis of the four levels of consumption are shown under the two estimates of population growth, the foodgrains supply position has been taken on the basis of the standard 100 million tonnes in 1973-74. The net result of the different models are shown in Table I.

The above estimates of demand and supply is an exercise in average. But in practice, as it is today, the available quantity of foodgrains is not evenly distributed among people with the effect that inequalities in per capita availability arise. Under such circumstances, the estimated deficits or surplus become only a rough guide unless the entire distribution system at least of foodgrains is placed under the strict public control.

TABLE I

Per capita per day consumption level (assumed)

			1981	2001
I.	@ 600 gms			
	A)	Estimated demand	148.4	226.0
		Estimated net availability	102.4	138.8
		Surplus (+) or deficit (-)	-46.0	-87.2
	B)	Estimated demand	151.0	238.0
		Availability	102.4	138.8
		(+) or (-)	-48.6	-99.2
II.	@ 500 gms			
	A)	Demand	123.6	188.4
		Availability	102.4	138.8
		(+) or (-)	-21.2	-49.6
	B)	Demand	125.5	197.8
		Availability	102.4	138.8
		(+) or (-)	-23.1	-59.0
III.	@ 450 gms			
	A)	Demand	111.3	169.5
		Availability	102.4	138.8
		(+) or (-)	-8.9	-30.7
	B)	Demand	113.0	178.0
		Availability	102.4	138.8
		(+) or (-)	-10.6	-39.2

		1981	2001
IV.	@ 385 gms		
A)	Demand	95.2	145.0
	Availability	102.4	138.8
	(+) or (-)	+7.2	-6.2
B)	Demand	96.7	152.3
	Availability	102.4	138.8
	(+) or (-)	+5.7	-13.5

A = with tapering population growth rate.

B = with constant population growth rate.

TABLE II

BIRTH, DEATH AND GENERAL FERTILITY RATES @ 3 ASSUMPTIONS (Per Cent)

		1966-70	1971-75	1976-80	1986-90	1995-2000
High	BR	3.94	3.73	3.42	3.20	3.04
	DR	1.69	1.55	1.33	1.09	0.97
	GFR	2.25	2.18	2.09	2.11	2.07
Medium	BR	3.94	3.56	3.29	2.81	2.57
	DR	1.69	1.52	1.32	1.06	0.97
	GFR	2.25	2.04	1.97	1.75	1.60
Low	BR	3.94	3.36	2.81	2.48	2.11
	DR	1.69	1.50	1.26	1.06	0.98
	GFR	2.25	1.86	1.55	1.42	1.13

BR = Birth rate

DR = Death rate

GFR = General Fertility rate

TABLE III

PROJECTED POPULATION OF INDIA ON 3 ASSUMPTIONS

(Persons in crores)

		1971	1976	1981	1991	2001
High:	Male	28.34	31.59	35.00	43.13	52.98
	Female	26.36	29.34	32.75	40.63	50.23
	Total	54.70	60.93	67.75	83.76	103.21
Middle:	M	28.34	31.35	34.53	41.26	48.53
	F	26.36	29.21	32.29	38.86	46.01
	T	54.70	60.56	66.82	80.12	94.54
Low:	M	28.34	31.08	33.53	38.71	43.45
	F	26.36	28.95	31.34	36.42	41.19
	T	54.70	60.03	64.87	75.13	84.64

TABLE IV

RURAL URBAN BREAK-UP OF PROJECTED POPULATION: 1971-2001

(Persons in crores)

Area	Age-group	1971	1976	1981	1991	2001
Rural	0 - 14	18.42	19.57	20.16	20.88	21.75
	15 - 29	11.14	12.38	14.06	16.45	16.95
	30 - 59	11.93	13.17	14.59	18.24	22.68
	60 - +	2.32	2.64	3.00	4.04	5.33
	All ages	43.81	47.76	51.81	59.61	66.71
Urban	0 - 14	4.25	4.73	5.29	6.53	8.32
	15 - 29	3.03	3.94	4.83	6.65	8.29
	30 - 59	3.07	3.57	4.19	6.21	9.39
	60 - +	0.54	0.56	0.70	1.12	1.83
	All ages	10.89	12.80	15.01	20.51	27.83
Total	0 - 14	22.67	24.29	25.45	27.41	30.07
	15 - 29	14.17	16.32	18.89	23.10	25.24
	30 - 59	14.00	16.74	18.78	24.45	32.07
	60 - +	2.86	3.21	3.70	5.16	7.46
	All ages	54.70	60.82	66.82	80.12	94.54

ALGAE - a source of protein food for man and domesticated animals

By

Dr.(Mrs) Manju Sharma*

General deficiency of protein food, calorie deficiency and mal nutrition problems in the country have changed the present national research needs and priorities and indefatigable efforts are being made to discover economically cheaper and easily available alternative sources of food for these shortages. One such source is Algae, which has received serious thinking in recent times. Algae has been used as a food since centuries by natives of Lake Chad in Africa and Aztecs in ancient Mexico. In the last 25 years countries like Japan, France, Czechoslovakia, USA and Germany have initiated the use of algae for human consumption. The algae have some unique advantages of being used as food e.g. (i) the whole plant material can be eaten up without any waste. The protein content is very high under optimum conditions, it goes up to 70% of dry weight. From the nutritional point of view the algal proteins are low in sulpher amino acid but protein efficiency ratio is higher than most of the vegetable proteins (Dr. S. Srikantia, Personal Communication) (ii) Rate of growth of algae is very high. The algal crop in general is not affected by climatic fluctuations and can be grown throughout the year. Even the culture techniques are very simple.

The only disadvantage of using algal protein is its poor digestibility, i.e. only 68% in drier algae and 58% from alcohol extract is digestible. Whereas in case of other proteins quite high percentages can be digested by human beings. Of course, the animals can digest the algal protein in a better way, This factor needs intensive investigation. Apart from this, the yield of protein/acre is also high in case of algae as in comparison to other protein aceous food materials, as is shown in the table below:

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* Senior Scientific Officer, NCST and special invitee to the Technical Sub-Group on "Food".

Food Product	Protein percentage	Protein/pound/acre/year
Beaf	59.4	-
Cow's milk	3.3	-
Petroleum proteins	43-46	-
Leaf proteins	17-25	-
Oil Cakes	40-50	-
Peanuts	-	420
Cereals/millets	7-10	-
Wheat flour	12-13	269
Rye	-	260
Oats	-	232
Barley	-	224
Beans	-	370
Peas	-	353
Algae Chlorella	42.00	14,000
Algae Spirulina	50-60	65,000

Algal research and its application has been done in several countries of the world. Harder and Witsch (1942) from Germany and Spoehr (1951) from United States gave the idea that algae could be utilised for food on commercial scale. In Japan, 20 different kinds of algae are used as food belonging to the families Phaeophyceae, Rhodophyceae, Chlorophyceae and Cyanophyceae (Hiroshi Taniya 1959). Porphyra tenera is a marine algae which propagates asexually or sexually. Following a detailed study on this algae in Japan, successful farming and processing techniques have been developed from the nutritional point of view. Porphyra is cultivated and harvested regularly to produce 'Asakusa Nori'. Sale of this food product in Japan brings nearly 28 million US dollars per year. It is also used for making soups, and condiments. Similarly kombu a product obtained from various kelps, forms one of the standard food of Japan. Kelps, and rockweeds have also considerable importance as source of potassium and iodine. Other marine genera commonly used as food are Laminaria, Sargassum and Menostroma. Some of these species are chopped and eaten raw in green salads or other dishes.

Mass culture experiments with green algae Chlorella are being developed in Japan. However, Japanese people prefer food containing Chlorella more than the Americans. Chlorella powder can be mixed with noodles, soups, ice cream and 'miso' or fermented soybeans. They are selling Chlorella products as 'health food' in Japan.

The nutritive value of algae and its digestibility has been worked out in various countries and it has been compared with that of other proteins. It has been recently shown by Shirota and Takechi in Japan (personal Communication) that cells of Chlorella contain some substance which promote the growth of lactic acid producing bacteria and some other useful microbes. The economic and social acceptability of Chlorella will have to be considered before applying this technology on a commercial scále. It was roughly estimated that cost of algae under all favourable circumstances would be 50 cents per pound and it would cost a dollar per pound to the consumer. The cells of Chlorella have a high fat and protein content. From available data from a pilot plant it was estimated that under optimum conditions, the dry weight yield would be 100 lbs per acre per day. The cost is perhaps economically unprofitable.

In Institut Francais Du Petrole extensive research work is being done on large scale cultivation of Spirulina. At the international conference on single cell protein in October, 1967, the use of algae was discussed at great length. The protein content of Spirulina is 64-70% when dried. In Mexico Spirulina has been used as food for a long time by Aztecs people. Many formulations like beverages, ice-cream, custards, chocolate, soups, cheese, cereals etc. have been prepared. In fact the best results are obtained when Spirulina is mixed with cereals. Diets having 40-60 gms of algae have been given to athletes. Clinical trials have also been done. It seems that Spirulina does not cause any gastro-intestinal disorders. In a way as a food item, Spirulina seems to have better prospects than Chlorella. The breaking of its cell wall can be done by solar heat only. Hence the processing for eating will be cheaper. In Mexico, clinical trials were done with children and the results were encouraging when algae was mixed with cow's milk. On the basis of these results in the year 1973, Mexican Government granted official permission for human consumption of Spirulina (from a report on International Conference on Single Cell Proteins). In Peru, green algae Scenedesmus is being experimented for human consumption. It has been reported from Peru that a small under nourished child who was underweight by 50% improved within two months after getting a Scenedesmus rich milk diet. In South America some species of Ulva and Durvilla are also eatern.

We in India are in continuous search for non-conventional sources of protein. One of them is the use of single cell protein (SCP). SCP is a term used for protein sources which are unicellular or simple multicellular organisms like bacteria, yeast, fungi and algae (Becker and Ramachandra Rao). Three important aspects of the use of algae as food need to be considered:

(1) Nutritional quality of the product - Algae are very rich source of protein and amino acids. The lipid fraction of algae is similar to most of the terrestrial plants. The oil content of algae is generally low. Chlorella also has a good amount of betacarotene, a source of vitamin 'A'. All the species of algae with the exception of the blue-green algae contain sterols. Some of these sterols contain precursor for vitamin 'D'.

(2) Toxicological evaluation and clinical trials of the product-Initial clinical trials in India have been discouraging. Intake of 250 gms of algae protein per day have been associated with acute toxic gastro-intestinal disorders. Continued feeding resulted in itching of the skin and haemorrages under the skin. Perhaps extraction of protein technology from algae is not known to us, which needs to be developed and more clinical trials undertaken to confirm the above findings.

(3) Its consumer acceptability - The green colour of the algal powder and its fishy odour are not very muck liked by the consumers. The cell well of the algae has to be broken down before it can be used as food for human beings. The cultivation of Spirulina is less expensive where cell well breaking and drying can be done by solar heat only.

As BHU scientists are trying to work on the efficiency of Spiruline platensis for single cell protein. A similar work is in progress at CFTRI, Mysore with Indo-German collaboration, on the algae Scenedesmus. At Auroville in Pondichery Chlorella has been experimented as a part of human diet. A small scale cultivation has been tried and it has been estimated that one acre of land with 15 to 18 inches water depth can provide protein for 300 persons. This cultivation was done throughout the year except November and December and the innoculum for this experiment was obtained from Indian Agricultural Research Institute, New Delhi. The main emphasis of research at Auroville is to utilise algae for human consumption, although clinical trials have not yet started.

Proteins and amino acids could also be obtained from green seaweeds, e.g., Ulva. Infact at CFTRI scientists are evaluating the protein from Ulva for human consumption. Even before the use of algae by human being they were given to farm animals as a source of protein. They provide a protein rich diet to cattle, pigs, Chickens, fishes etc. The marine algae e.g. Ulva and Sargassum could also be used as animal feed.

In addition to Algae, there are other microbes such as bacteria, yeast, filamentous fungi etc. which could be usef ro recycling of cellulosic waste material. Intensive efforts are being made in the world to get single-cell protein from these microbes. Protein from leaft also has been tried and recently some research projects have been started in our country at Tamil Nadu Agricultural University to identify some plants from which protein can be extracted. According to scientists there, this protein is easily acceptable to the consumers. In any case, whether it is algal protein or leaf protein, the economics of the operation, social acceptability and toxicological evaluations will have to be ascertained.

Points for discussion:

1. Large scale production of algae.
2. Cost-benefit analysis.
3. Toxicological evaluations and clinical trials.
4. Social acceptability.
5. Various dietary preparations.

ANIMAL NUTRITION: A DISCUSSION NOTE

By

Dr.(Mrs) Manju Sharma*

There is a tremendous importance of providing balanced diet to animals specially the domesticated ones who provide meat, milk and eggs for human consumption. Most of the animals in the country are under nourished and have protein deficiency as well as vitamin and mineral deficiencies. Efforts are being made in the country now to discover economically cheaper alternate sources of protein food for animals for obtaining the best quality of meat and milk from them. Some of the important points which need consideration in this respect are:

1. A systematic planning of animal nutrition programme.
2. Use of unconventional and cheaper sources of protein as a supplementary diet.
3. Cheaper sources of vitamins and minerals.
4. Disease control practices among the animals.
5. Proper animal husbandary practices.
6. Concentrated research efforts on veterinary science.
7. Management problems.
8. Breeding disease resistant animal species.
9. Encouragement for introducing cattle breeding, poultry, fish cultivation, pig and chichen farming in rural areas (suitable wastes can be consumed by these animals).
10. Improvement of the variety of buffalo in the country. (These animals are more suitable in hotter climate and provide better milk and meat when given poor fodder).
11. The other animals to be considered are goats, birds like ducks, geese, guinea-fowl etc. Even rabbit farming has been encouraged in some other countries.

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FISH TO FEED MILLIONS

By

Malathi Rangaswami*

Our leaders have said that the fundamental requirement of our country's political and economic independence was that it had to be self-sufficient in food, in commercial crops and in the basic necessities of life. An all out effort is being made to grow more cereals and pulses in the rural areas. A campaign is also being carried out to provide more nourishing food to the people.

Can the towns provide a certain amount of their own food by using town wastes instead of adding to the pollution of rivers and ponds, and at the same time help reduce the import of food grains? Let us look to Nature for an affirmative answer. All waste matter, human, animal or vegetable, which enters rivers or streams in small quantities, decomposes and encourages the growth of plankton which in turn are eaten by fish and the flow of water oxygenates it. It is only when sewage or garbage is let in, in large quantities that fish die due to lack of oxygen.

An experiment was conducted by Dr. T.R.Rangaswami in 1953, while he was Professor of Preventive Medicine at the Madras Medical College, to prove that fish can indeed live on raw sewage, provided it was aerated continuously. For this experiment, conducted under laboratory conditions, a jar full of raw sewage was aerated till a layer of sludge was formed leaving the water above it clear. Two larvicidal fish were introduced into the water and 500 c.c. of sewage was added every day, the aeration being continued 24 hours a day. No other food was given to the fish. The experiment was continued for two months. I was found that not only did the fish thrive, but the level of sludge did not rise at all. The clear water was siphoned off as and when more sewage was added.

Optimum Results:

The experiment can be carried out in any school or college laboratory to demonstrate ecology and pollution control, so that social service groups can popularise this in towns, especially slums. Cowdung can also be used instead of sewage. The only equipment required would be a wide mouthed glass jar, a metre or two of polythene pipes and a pump of the type used in acquariums which cost about Rs. 50 and require only as much electricity as a 45-candle power lamp. The important thing is to see that the contents are continuously aerated.

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Where can we find the power to fun these pumps on the large scale necessary for aerating town sewage in these days of power shortage? This problem can easily be solved thanks to the bio-gas plant which converts sewage into methane and fertiliser rich in nitrogen, phosphorous and potash. The methane gas can be used to run the pumps and the fertiliser for raising fish, making the disposal of sewage easy and profitable. The discovery of the British scientists that undiluted wastes are not the best for producing methane gas and that optimum results are obtained when they contain between five and nine per cent dry matter, will render the work of the municipalities easier. They can now construct bio-gas plants and fish ponds in each colony of a town instead of vast drainage works which become inadequate in a few years. At present very few towns have underground drainage, and even those who have them are not able to provide for the whole population.

Use of Effluents:

As the effluents from a bio-gas plant do not emit any foul odour and are free of flies, there is no danger to the health of the human population. The fish ponds will be cement lined tanks and will be aerated by blowing air under pressure continuously all the 24 hours a day through long porous hollow unglazed porcelain candles dipping right down to the bottom of the tanks. Anyone who has seen the "aerated sludge process" can testify to the fact that even when a cart-load of cow-dung or sewage is tipped into a tank of water, the sludge settles down at the bottom of the tank within a few hours leaving the water above it clear. This sludge contains, in addition to organic matter, live amoeba and other mono-cellular organisms which form an excellent food for fish. The continuous aeration provides enough oxygen for the fish to breathe and thrive. The gobar gas plant and fish pond need not be an eyesore if creepers are planted around the plant and lotus plants are grown in the fish tank. A layer of san can be put into the tanks before the effluents are let in and lotus tubers planted. Unlike water hyacinth and algae, which stifle the fish, the lotus plant allows fish to swim round and breathe. Even if mosquitoes breed, the fish will eat up the larvae. Thus mosquitoes can be controlled without using DDT.

Lotus Tuber:

Scientists of the NEERT have already proved that bacteria responsible for typhoid, cholera and other intestinal disorders are completely eliminated even in a stabilisation pond, the more so in an oxygenated ditch which we are now turning into a lotus pond for raising fish. The lotus tuber (kamal-kakdi) is a very high protein vegetable much in demand in India. As both the lotus tuber and fish have to be cooked for a sufficiently long time before they are fit for the table, there is no rish of infection. The lotus leaves fix sunlight and will give shade to the fish in summer. The leaves can also be cut and added to the gas plant if more gas is required. Fisheries experts say that six types of fish which feed at three different levels, so that all the available food is consumed, can be raised in each tank. Hence there will be sufficient variety for the table.

The clear water left above the layer of the sludge can be siphoned off and used for flushing in toilets or urinals or for purposes of fire fighting or even in boilers. The water should not, however, be used for drinking, bathing or for washing clothes until purified further and declared fit by an entomologist.

What would be the economics of such a plant say for a hostel with 75 inmates? In cities water supply is aimed at providing at least 20 gallons per individual per day, most of which is for flushing toilets. Except small quantities lost as sweat or due to evaporation, the rest has to be disposed of by pumping to distant sewage plants or let into rivers and streams thus adding to pollution. If a bio-gas plant is built to convert all these wastes into methane and effluents containing NPK, the effluents can be fed into a fish pond. Theoretically, 200 to 250 lbs of fish per individual per year can be obtained by using human wastes to feed fish. Five lbs of protein contain one lb of nitrogen. Human wastes contain 11 lbs of nitrogen per individual per year. Hence the protein content works out to 55 lbs per individual per year. The biological value of protein is the percentage by weight of protein retained in animals fed on various proteins during experiments and is not less than 75 per cent. Therefore 55 lbs of protein will result in an increase of 41.25 lbs of fish protein when fish consume the sludge.

Fish contain 15 to 20 per cent protein depending on varieties. Taking the lower percentage and rounding off the fish protein to 40 lbs, the weight of fish produced would work out to minimum of 266 lbs. The price of fish is now Rs. 4 per lb. Even if prices crash due to this mass production to say Re. 1 per lb, these 75 inmates of the hostel can help raise at least 15,000 lbs of fish valued at Rs. 15,000 per year which would more than pay for a gas plant costing Rs. 5,000 and a fish pond costing the same amount, as well as the pumps for aeration, leaving a substantial profit even in the first year. This does not take into account the amount obtained from sale of lotus tubers and flowers, or the amount saved in recycling the water, or the saving in foreign exchange spent on buying food from abroad, due to availability of protein rich food in plenty inside the country, for consumption of more fish means less consumption of cereals.

This would be a money spinning project for all municipalities which could then provide a better quality of life for their residents.

As a first step, hotels, multi-storeyed apartments, hostels and hospitals should recycle their wastes using this method. For this, the various Government departments in charge of fisheries, bio-gas plants, mosquito control, pollution control and entomologists should work together, conduct this experiment and publish their findings on the optimum size of pond for every 100 people; size and cost of gas plant; H.P. and type of pump required for oxidation; varieties of fish which could be grown in each region; price per 1000 fingerlings; and the address from which they can be obtained in each town etc.

In Delhi, fish can be raised in the moats around purana Quila and the Red Fort as well as in the numerous parks. This would provide employment, especially to unskilled labourers.

A STUDY OF FOOD SCENARIO IN 2000 A.D.

By

B.L. Amla,
Director,
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The population in the country has steadily risen during the last ten years inspite of massive efforts for population control and economic development. The rate of growth which was 21.46% during 1951-61, had increased to 24.66% during 1961-71, and thus, many millions are added to the country's population every year.[1] In the Fifth Five Year Plan[2], several agricultural and livestock development programmes to fulfil the dietary needs of the population have been prepared. Progressive policies of industrial development to improve the economic sinews of the country have begun to show faster growth in metropolitan cities[3] or towns and this has resulted in the migration of rural population to urban areas in search of employment opportunities. The challenge of social needs like food, water, shelter, clothing, power, transportation and medical care will increase. Unless suitable plans are formulated for mobilisation of adequate resources and faster execution of developmental programmes the problem is going to get accentuated in future years.

Objectives of the Study

This study has been undertaken with the following objectives: (a) tracing the trends in the growth of population by 2000 A.D.; (b) identifying their dietary requirements and sources of food; (c) projecting the quantum of production and the facilities for storage and processing; (d) analysing the current status of technology in order to suggest the most optimal venues of their utilisation; and (e) drawing up a profile of technologies that are being developed to harness the unconventional resources like yeast cells, algae and synthetic chemicals for human use.

Population in 2000 A.D.

According to the Indian Census of 1971, the population in India has been estimated at 547 millions (Table 1), there are 932 women for every 1000 men. On the basis of this population and the average rate of annual growth at 2.466% recorded during the last 10 years, the population in 2000 A.D. would reach a figure of 969 millions (Table 1). Earlier projections by Sukhatme have indicated that the population in 2000 A.D. could be 836 millions or 1000 millions[4]. In another study carried out by the Urban Systems Centre[3], NITIE, Bombay, the population at the end of this century is reckoned to range between 950 and 1000 millions. According to the projections made by the Planning Commission[2], the population in 1986 would be about 705 millions which would mean that 158 millions will have been added in 15 years (1971-86). Addition of the same population during the next 14 years (1986-2000), i.e., by 2000 A.D. would show a population of about 863 millions. Against the background of these estimates, the population figures of 969 millions computed in this study appear to be probable and have, therefore, been used in calculating the dietary requirements and food production targets.

Consistent with the growth in the country's population, the urbanisation has also continued in the last 40 years. The present rate of urbanisation in the Population Census of India-1971, is estimated at 3.783%, and on this basis, the urban population in 2000 A.D. is expected to reach 228.58 millions (Table 1). The urban population in 1986 has been estimated at 169 millions by the Planning Commission, and addition of 60 millions based on the 15 years' (1971-86) growth would increase the population to 229 millions. Another study[3] indicates that the annual urban growth rate would be 4% upto 1990 and 5% between 1990-2000 A.D. Thus, by the end of the century urban areas may have an approximate population of 350 millions.

The study by NITIE[3] envisages the identification of following five megapololitan areas and populations:

Megalopolitan areas	Population in 2000 A.D. (Millions)
1. Bombay Ahmedabad Poona	38.60
2. Calcutta	23.00
3. Madras, Bangalore	19.70
4. Delhi	19.00
5. Lucknow - Kanpur	10.00

Further, about 20 cities with population of about 1 million each, and at least 600 cities with a population of 50,000 to 500,000 are also anticipated[3].

Production of food materials

During 1971-72, India produced about 105 million tonnes of foodgrains consisting of 93.6 million tonnes of cereals/millets and 11 million* hectares. Oilseeds consisting of groundnuts, sesame, rape/mustard, cottonseed, safflower, and niger seed account for 9 million tonnes produced from an area of about 22 million hectares. Potato and tapioca amount to about 11 million tonnes and were cultivated in an area of 2.39 million hectares has yielded about 114 million tonnes of cane resulting in a production of 3.1 million tonnes of sugar and 11.6 million tonnes of jaggery[5,6]. The production of fruits and vegetables has been estimated at about 20 million tonnes (Table 3).

Despite the largest cattle population which almost equals 345 millions, the milk production in India has been reported as 24 million tonnes (Table 6). The production of meat, poultry meat, eggs and fish is estimated at 518, 69, 78 and 1746 thousand tonnes respectively[7]. In order to meet the recommended *per capita* allowances of 100 g. of milk, 30 g. of meat and fish, and 30 g. of eggs per day suggested by the Nutritional Advisory Board (NAB) - 1968, the production of milk has to be increased to 88.4 million tonnes, of meat to 2.3 million tonnes, of poultry meat to 276000 tonnes, of eggs to 10.6 million tonnes, and of fish to 8.0 million tonnes respectively in 2000 A.D. (Tables 4 and 6).

Availability and requirements of food materials

The estimates of availability of foodgrains for consumption have been calculated in earlier studies [4,8] by deducting 12% from the total production to account for seed (6%), feed (3%) and wastages (3%). The wastages during storage and transportation have been subsequently estimated at 6-10% after careful assessment of data at national level[9,10]. Even if the minimum level of wastes, i.e., 6% are added to the quantities used for seed and feed, a deduction of 15% has to be made from the total production to obtain a reasonable estimate of the availability. Hence, in the present study, availability of the foodgrains (cereals and pulses) and oilseeds in 1971-72 has been

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*tonnes of pulses (Table 2) from an area of 122.3 million hectares.

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calculated by deducting 15% from total production. Likewise, 25% has been deducted from the production of fruits and tubers to account for the post-harvest losses (Table 3). In an earlier study, Sukhatme has indicated an allowance of one third of the production for seed and wastage for potatoes[4].

The foodgrain requirements for a population of 969 millions in 2000 A.D. have been projected (Tables 5 and 6) on the basis of _per capita_ availability in 1971-72, (445 g/day) (Table 3) and also according to the allowances (472 g/day) (Table 4) recommended by NAB-1968 for ensuring adequate nutrition to the population[11]. Allowances recommended for adults engaged in "moderate work" are used as the basis for calculations but it is noted that adolescents (boys and girls), children, infants and nursing/pregnant women are given extra allowances in view of their metabolic functions and extra requirements.

The production targets in 2000 A.D. according to the _per capita_ availability in 1971-72, and NAB-1968 allowances (Table 5 and 6) are as follows: Cereals 162 and 167; pulses, 19 and 24; oils, 4.2 and 16.2; tuber crops, 18 and 35; fruits and vegetables, 33 and 13; gur, 20; sugar 5.5 million tonnes; milk, 42515 and 88000; meat, 918 and 2306; poultry meat, 122 and 276; eggs, 138 and 1060; and fish, 3100 and 8028 thousand tonnes.

Targets of production

Future planning and mobilisation of resources to achieve the increased food production targets would require a careful study of the availability and generation potential of inputs that govern the production of food materials, together with factors

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like choice of variety, responsiveness of crops to input supplies, cropping patterns and disease resistance.

Improvement of per hectare yields:

A perusal of tables 3,4 and 5 indicates that by increasing the production in 2000 A.D. to achieve the level of per capita availability prevailing in 1971-72 (cereals, 398; pulses, 47; oil, 12; and tuber crops, 39 g. per day), the nutritional allowances (cereals, 412; pulses, 60; fat and oil, 40; and tuber crops, 87 g. per day) recommended by the NAB-1968 cannot be adequately met. In order to achieve this target the gap to be filled in production of cereals is 73.971 million tonnes, pulses, 13.3 million tonnes, oilseeds 31 million tonnes and tuber crops 14.3 million tonnes over the production of 1971-72 (Table 1). If the same area utilised for cultivation of foodgrains in 1971-72 is available in 2000 A.D., the per hectare yields will have to be increased to 2050 kg/ha in rice, 2473 kg/ha in wheat, 826 kg/ha in jowar, 1595 kg/ha in maize, 814 kg/ha in bajra, 618 kg/ha in ragi, 543 kg/ha in barley, and 627 kg/ha in millets (Table 7).

The results of national demonstration schemes have shown that yields of different cereal crops can be increased substantially under appropriate conditions of input supply and crop management. These trials have shown that even in areas presently under cultivation, yields of wheat can be approximately increased to 3319 kg/ha, rice to 4684 kg/ha, maize to 4077 kg/ha, jowar to 2626 kg/ha, bajra to 2940 kg/ha, and ragi to 4289 kg/ha (Table 7) [12]. Thus the targetted production of cereal crops can be easily met, while doubling of the area under oilseeds may become necessary. The multiple cropping

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practice adopted in recent years has also shown some promise of increasing the grain yields per unit land area.

The requirements of sugar and jaggery in 2000 A.D. can be easily met since the jaggery and sugar production in 1973-74 was already 14 and 3.9 million tonnes against the requirements of 12.378 million tonnes (Table 5) as per NAB-1968.

Improvement of irrigation facilities:

The irrigation potential in the country has been estimated at about 81 million hectares and their water requirements can be met from 720,000 million cu.m. of water available from the surface and underground resources. About 33 million hectares are already under irrigation, and hence, a net area of 48 million hectares is potentially available for irrigation[14].

The yields of crops are substantially higher under irrigation than in rainfed conditions (Table 8). Crops like paddy, wheat and maize have been reported to give 52, 63 and 28% increased yields respectively over unirrigated crops. About 60% of the total irrigated area in the country is being used for the cultivation of wheat and rice[13]. Thus, by utilising 29 million hectares, about 20 million tonnes of rice and wheat can be added to the production. The remaining 19 million hectares could be diverted for producing other crops which will add to the total production. Considering the possibility of raising more than one crop in some of the irrigated areas, the gross irrigated area will be even higher than 81 million hectares.

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Besides increasing the irrigation potential of the country, 15 million hectares of agricultural, cultivable waste lands available in the country can also be brought under cultivation[14].

Cultivation of Triticale:

The man made cereal Triticale (bred by crossing wheat and rye) gives comparable yields to wheat and has also shown promise for bread. Various strains of Triticale are being tested in several parts of the world as a crop of choice to meet the situations arising out of limited water resources. Field trials carried out in the country for their cultivation have to be extended in different agro-climatic conditions.

Improved handling and storage of foodgrains

The wastages of foodgrains during handling, and storage are caused by insects (picked up from the field or in post-harvest stages), moulds (due to insufficient drying), birds and rodent activity. The hot and humid conditions in various parts of the country are particularly suitable for the multiplication of insects and moulds. These biological agencies also create insanitary conditions which are injurious to human health and affect the organoleptic qualities[17]. About 2,400 million rats are reported to be coexisting with human beings in India. They begin to bear at the age of 3-4 months, have a gestation period of 21-25 days, produce 8-10 generations in a year and also feed voraciously on human food (6 rats eat the food of 1 person)[15]. Only about 30% of the foodgrains stored in urban warehouses are being handled with care and the remaining 70% which remains in the 567 thousand villages for the farmer's use is stored in a variety of structures of various shapes, designs

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and sizes. These range from underground pits to aboveground structures like bins of mud, concrete, wood, brick and mud Kucha Kothi goudouns[16,17,18].

Measures for grain protection developed with Indian expertise are being applied on a commercial scale. For example, stocks of foodgrains in rail wagons, warehouses, ship-holds and bins can be fumigated with ethylene dibromide plus methyl bromide or phosphine. Rural and domestic stocks of foodgrains stored loose in bins, tins and pots or in jute bags can also be protected by pesticide emulsions and fumigant devices which have been made available in the form of paper discs, pencils and ampoules. Extensive and large scale demonstrations on a national scale like those carried out on the use of fertilizers during early years and adoption of villages will be necessary to reap the benefits of grain protection. A pilot scale study made by CFTRI for the adoption of pest control measures with a commercial approach has given promising results.

The existing pattern of storage may continue to prevail in 2000 A.D. unless there is a drastic change in the socio-economic structure of rural society. With this situation in view, several traditional storage structures have been improved (for example, Hapur Thekka and Pusa bin)[16] to facilitate the use of pest control measures and also to minimise losses resulting from seepage of moisture, mould growth, insect activity and rodent damage. The utility of using improved structures which is being demonstrated by training programmes and commercial approaches has to be intensified as a Campaign of war on waste.

The present urban storage capacity of 29 million tonnes in the country is mainly controlled by traders (20 million tonnes) cooperatives (3 million tonnes) and the government organisations (6 million tonnes). About 0.4 million tonnes capacity for silo storages is also available and expertise has been developed for their construction[18]. Assuming that about 30% of the foodgrain production in 2000 A.D. will be held in urban areas, a storage capacity of 75 million tonnes (of which 20 million are to be for buffer stocks) has to be built up. This is expected to require an investment of about 1225 crore rupees on the present cost structure of 150/tonne.

Improved processing of foodgrains

Major types of foodgrains have to be suitably processed in some form or the other before consumption; for example, the processing would involve dehusking and debranning in rice, debranning in wheat, and dehusking/splitting in pulses.

Rice milling: The current production of about 60 million tonnes of paddy are processed by hand pounding and mechanical milling. There are about 84,000 milling units in the country, of which about 70,000 are hullers and the rest are shellers[19]. The number of shellers and hullers grouped under organised sector is not accurately known, but about 33% of paddy is believed to be milled in these units. Out of the remaining production, 33% is milled by hand pounding and the rest in hullers operating under the organised sector. Consistant with the targetted production of 76.5 million tonnes of rice in 2000 A.D. (Table 2), the number of milling units have to be increased for village as well as urban scale of operations. A substantial number of these may have to be of huller type meant for milling 70% of paddy which may continue to be retained and consumed in villages. Hullers in current use produce heavy breakages which result in reduced milling yields, and also yield bran-husk mixtures (Table 9). Improved huller type mini mills developed in the country (cost about 20,000 rupees per unit of 500 kg/hour) give additional yields of at least 1% over conventional hullers and are undergoing trials for large scale use. Additional sheller units provided with modern grading and destoning devices are also required for milling bulk lots of paddy needed for urban areas. The relative proportion of the hullers/shellers and the investments needed for their establishment can be determined on the basis of changes in milling pattern likely to occur during the future years.

About 50% of paddy is parboiled before consumption[17]. Parboiling produces about 1% higher milling yield in modern rubber roller mills, 2% higher yield in disc sheller units, and about 3% higher yields in huller units than that obtained from raw paddy besides improving the nutritive and storage qualities of rice (Table 9). If 75% of total production in 2000 A.D. is parboiled, the yield of rice can be increased by a minimum of 1.2 million tonnes. Large scale adoption of modern methods of parboiling will be necessary to provide rice free from odour and mycotoxins.

About 4.0 million tonnes of bran could be obtained (on the basis of 4% milling) from 102 million tonnes of paddy that would be available in 2000 A.D. Assuming that 33% of the paddy will be processed by hand pounding and the rest in mills, about 2.6 million tonnes of bran capable of yielding 390,000 tonnes of oil may become available. Technology for the stabilisation of bran against lipase activity which affects the quality of oil has been developed in the country. Small units will be required as part of the rice mills to utilise the bran, and adequate capacity for its solvent extraction will also be needed to recover edible oil.

Flour Milling: About 90% of the wheat produced in the country is converted into atta of 90-98% extraction by a simple grinding operation in stone mills (chakki) which are operated by manual labour, animal power, water power, oil engines and electricity[20]. The stone milled atta is preferred for chapati and poori which are the principal food preparations in Indian dietaries. The rest of the production is milled in flour mills to produce maida of 40-60% extraction and semolina of 6-30% extraction according to market requirements[21].

The atta is nutritious[22] and is also a means of stretching the availability of wheat because of greater retention of bran portion (which contains high level of lysine) in the flour. The practice of producing atta of 90% extraction should, therefore, prove beneficial even in future years.

Pulse Milling: About 75% of the pulses produced in the country is consumed as dhal after milling. In the traditional practice of milling, pulses are coated with oil and conditioned in sun for about 5 days to loosen the husk for easy removal. The pulses are then dehusked and split into dhal in power driven chakkis or roller machines. The milling yields are low due to breakage and powdering of grains. The traditional technology has been improved to obtain substantially higher yields by standardising the conditioning procedure and also designing special units for milling and splitting[17].

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The existing pulse milling industry consists of about 1000 units with an installed capacity of 30 million tonnes which is not being used to full advantage. In order to modernise the units (capacity 8 tonnes/day) by providing a conditioner, pearler and splitter, the additional investment is about 50,000 rupees/mill totalling about 5 crore rupees.

Animal based foods:

The present rate of production of milk, meat, eggs and fish can barely furnish 6.48 g of protein although about 12 g per capita/day have been recommended by the NAB-1968 (Table 4). In order to meet these requirements the increase in production should be 3.68 times for milk, 4.45 times for meat, 4 times for poultry meat and 4.59 times for fish (Table 6). Milk and meat provide proteins of superior quality but are 3-10 times more expensive (Table 10) than vegetable raw materials, every kg of animal protein produced also requires about 5 kg of vegetable proteins. Further, the water requirements for producing animal proteins are about 12 times higher than for vegetable proteins[24].

The byproducts obtained from the foodgrain production of 105 million tonnes together with the fodder resources have been sustaining the cattle population which produces about 24 million tonnes of milk. The increased foodgrain production would also yield byproducts such as fodder, bran and husk (in case of pulses) which can sustain greater number of cattle population and thereby contribute to better supplies of milk. Since the average and 2.2 times for pulses (footnote of Table 2) by 2000 A.D., the milk production could also be expected to increase by 1.5 times over the present production, i.e. by 36 million tonnes. However, the shortages of milk,

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meat and eggs have to be met by vegetable resources since land, water and other inputs may not be sufficient to achieve these targets. Alternative sources of protein like oilseed meals, green vegetation, fresh water/marine algae and single cell protein may, therefore, be explored for supplementing the dietary staples.

Fish and fishery products

India has a coastline of about 5100 km, a continental shelf of 2,59,000 sq.km and inland water area of about 1,126,650 sq. km. The fish production in 1970-71, was about 1.746 million tonnes (65% was contributed by marine catches) which constitute about 1 17.46% of the total estimated potential of 10 million tonnes[25]. The requirements in 2000 A.D. as per the suggestions of NAB-1968 have been estimated at about 8 million tonnes (Tables 4 and 6), but a catch of 4 million tonnes is reported to be possible by the large scale introduction of mechanised fishing fleet[26]. In addition to the major fishes, the marine resources can also provide mussels, clams, edible oysters, squilla, cuttle fish, sea cucumbers, turtles and whales. The yield of mussels estimated at 4-5 tonnes/ha in natural beds can be raised to about 300 tonnes/ha by scientific cultivation to achieve the targets of fishery products[27].

Besides the marine water resources, about 4054 million acres of cultivable water acres, of which 1575 million acres can be easily reclaimed, are also available in the country. Although the present annual catches of fresh water fish are about 7 lakh tonnes, substantial rise in production could be achieved by scientific cultivation in ponds, lakes and dam reservoirs[28]. Annual yields of 50 kg/acre are

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reported to be possible by raising rapidly proliferating fishes like carps and Tilapia. The potential of mariculture and aquaculture is borne out by the success of current efforts in other countries (Table 11). Multilevel cropping of fishes which thrive separately on surface of water, rims of ponds, and at the bottom is yet another approach which has been suggested towards increasing fish production[29].

Fish is highly perishable, and hence, its plentiful supply at costs that would be within the reach of the needy population can be possible by establishing adequate facilities for preservation and processing. Since large scale refrigeration from the stage of catch to marketing is an expensive venture, alternative methods of drying, salting and smoking have to be increasingly adopted in future years to meet the needs created by increased production. Scientific methods already developed in the country for producing salted and sun/mechanically dried fish of hygienic quality have to be scaled-up for commercial adoption.

About 50% of the country's sardine production (2.53 lakh tonnes) may be available for oil processing[30] and by adopting suitable technology, the residual meal could be converted into edible fish protein concentrate (FPC), for supplementing Indian dietaries. FPC contains more than 80% protein of high quality but retains some flavour of the parent material. Besides, a production of 50-70,000 tonnes of FPC is also reported to be possible from fishes not directly used for human consumption.

Tuber crops:

The tuber crops grown in the country consist of potato, tapioca, sweet potato and various types of bulbs and corms. About 11 million tonnes of potato and

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tapioca were produced in 1971-72 from an area of 0.846 million hectares (Table 2). The per capita availability on the basis of this production amounts to about 39 g/day, although NAB-1968 has recommended a per capita consumption of about 87 g/day (Tables 3 and 4). In order to achieve this target, the production in 2000 A.D. has to be raised to about 35 million tonnes (Table 5), for which a total area of about 2.7 million hectares will be necessary. Production targets of even 55 million tonnes may be envisaged by devoting about 4.23 million hectares for tuber cultivation.

Potato is cultivated in different regions of the country under a variety of agro-climatic conditions including high altitudes; it also shows possibilities of raising 2 or 3 crops in a year from the same land. Likewise, tapioca is another crop, which has been extensively grown in Kerala and Tamilnadu[31]. Both these crops are heavy yielders of food materials as compared to cereals and the economic returns from potato are reported to be almost 5 times that of rice or wheat[31]. A shift in cropping pattern concentrated on tuber crops should, therefore, help in meeting the food targets of future years and also minimise the demands on cereal crops. Efforts at raising pulses, oilseeds, and fishery resources, have to be correspondingly intensified for meeting the imbalances in protein supply.

Traditional storage of potatoes in thatched structures and godowns results in heavy losses, due to shrinkage, rotting, sprouting and respiration. Although about 90% of the cold storage capacity (1.4 million tonnes) available in the country is used for potatoes, the major portion remains in traditional

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storages. The traditional storage practices may be suitably modified to utilise the advantages offered by low atmospheric temperatures prevailing in the northern regions of the country during winter months. Likewise, the tuber crops can also be dried by using solar energy at different levels of mechanisation. Some degree of flexibility in the quality of dried product may, however, become necessary while adopting such technologies of preservation.

Researches carried out in India over the last several years have shown that tapioca can replace rice, ragi or wheat upto 25% without affecting the nutritional qualities. A blend of tapioca flour and edible groundnut flour (4+1) also called 'Mysore flour' can be used upto 50% as a substitute to cereals for further improvement in over all nutritional value. Subsequently, a blended flour composition called 'Paushtik Atta' based on wheat flour, tapioca flour and edible groundnut (75:8:17) was developed, tested on a large scale and found acceptable by traditional consumers of wheat flour. Quick cooking and nutritious macaroni type products which contain about 12-18% protein can also be produced from tapioca by adopting the technology and expertise available in the country. Potato can also be used in combination with calcium to substitute 25 or 50% rice without affecting the growth promoting qualities. These findings offer a viable solution for stretching the foodgrain supplies of the country[32].

Processing of oilseeds:

Currently about 9 million tonnes of oilseeds are produced in the country of which 80% is reported to be crushed for oil (Table 2). The total quantity of residual cake available from groundnut, sesame,

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cottonseed, soyabeen, sunflower, and safflower is estimated at about 4.1 million tonnes, out of which 956,000 tonnes are exported and 1.547 million tonnes used for animal feeds and manure (Table 12). The per capita availability of oil on the basis of present production is hardly 12 g/day (Table 3) although the NAB-1968 has recommended a per capita allowance of 40 g/day (Table 4). In order to reach this level of consumption, the production has to be raised to about 16.27 million tonnes which in terms of oilseeds would mean 41 million tonnes (Table 5), and the processing facilities increased correspondingly.

The residual cake left after the recovery of oil contains about 40% protein and can be used for human consumption after suitable processing. Even if 80% of oilseed production in 2000 A.D. is crushed for oil, about 16.5 million tonnes of cake equivalent to about 6.5 million tonnes of proteins will be available provided the country takes a decision to stop their exports. This could provide an average protein equivalent of 18 g. per capita per day.

The proteins of oilseeds, like other plant proteins are of lower quality than animal proteins because of deficiency and imbalance in certain essential amino acids[9,15]. Their nutritional value can, however, be raised by supplementing with deficient amino acids and/or other vegetable protein sources like pulses and cereals for which there is sufficient expertise in the country[9,15].

A technological base has been built up for producing hygienic, safe and edible flours from groundnut, sesame, cottonseed, soyabean and mustard/rape. The edible groundnut flour has been used as a major ingredient of nutritious foods like Indian Multipurpose Food (a 3:1 blend of edible groundnut

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flour and Bengalgram flour providing about 42% protein), Energy Food (a ground mixture of toasted wheat flour, edible groundnut flour, Bengalgram flour, jaggery and fat providing 16% protein and 390 calories/100 g), Bal-Ahar type of products (mixture of cereal, pulse and oilseed flours to provide 20-25% protein), chewy candies (containing 18-20% proteins), and biscuit mixes. The edible groundnut flour has also been commercially used for enriching atta at about 5% level in order to increase the protein content[9,15].

The groundnut protein isolate which is about 93% pure, and free from biologically active principles is also being manufactured by using the know-how developed in the country. It has subsequently been used for the toning of animal milk which is being manufactured under the name 'Miltone' at the Bangalore Dairy (5000 litres/day). Two more units have also been set up at Hyderabad and Cochin respectively. The production of Miltone is a means of doubling milk production and would be a boon for metropolitan cities where organised milk processing facilities are available[9,15]. A manufacturing unit which can turn out 5000 litres a day would cost 7 lakh rupees, and on this basis, a production target of 30 million tonnes of Miltone would approximately involve an investment of Rs.140 millions, at the existing capital cost structure.

The total production of baby foods based on animal milk is barely 15000 tonnes and is already beyond the reach of the needy groups of population[15]. When the population of infants (0-1 year) is about 24.23 millions in 2000 A.D., the total requirements would be 1.333 million tonnes to provide a per capita level of 150 g/day equivalent to 5 feeds. The oilseed flours and protein isolates will, therefore, find greater use in baby food formulations because of difficulties in achieving the desired targets of 88.5 million tonnes of milk production

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(Table 6) due to severe input limitations. An infant food based on 50% each of milk and vegetable proteins is undergoing extensive nutritional trials to establish the base for commercial scale manufacture in the country.

One of the means of stretching the availability of milk for meeting the needs of vulnerable groups is to prevent its use in sweetmeats and beverages like coffee and tea in catering establishments. It is estimated that a substantial portion of milk produced in the country is used for sweetmeats. Development of coffee and tea whiteners has also been undertaken as an alternative approach in facing milk shortage in the country.

Profile of technologies for harnessing unconventional resources:

Leaf proteins from green foliage: Utilization of leaves for human consumption primarily as a source of green vegetable is a common practice all over the world. Several species of vegetation which can become edible protein supplement after suitable processing are being consumed by human beings. Cultivation of lucerne for instance, yields 1300-3000 kg of proteins per hectare as compared to 440 kg for wheat or 950 kg for green peas[33]. Besides common legume fodders, the byproduct vegetation of green vegetable and commercial crops also form important raw materials for leaf protein production. The ratio of edible material to total bio-mass produced (on dry basis) varies from crop to crop. On the basis of the present production of agricultural crops the potential availability of proteins from about 116 million tonnes of dry matter works out to 5-6 million tonnes which can be utilised to meet the requirements of 250-300 million population.

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Single cell proteins: The cultivation of single cell organisms such as yeasts, on substrates based on petroleum hydrocarbons, as a source of proteins has been receiving attention in several countries particularly because of the limitation of agricultural land for future cultivation. Earlier studies have indicated that about one tonne of single cell protein could be obtained from 2 lakh cu.ft. of methane. Some of the organisms can utilise ammonia or mineral nitrates as a source of nitrogen with a conversion efficiency of more than 50%. The broad range of microorganisms suitable for continuous culture production of proteins thus offers scope for utilising a variety of natural and synthetic substrates.

Pilot plant studies carried out in India have indicated that commercial ventures with a capacity of 20,000 tonnes of protein per year could be established with a capital input of less than Rs.20 million per unit[33]. The product cost had been worked out at Rs.2.50 per kg in 1970. The yeast is currently produced for use as a flavouring material in food products. A wide range of raw materials such as sulphite waste liquor, wood hydrolysate, sugarcane molasses etc. are suitable for yeast production. Debittered brewers' yeast and distillery yeast sludge are also likely to be valuable food in the future years.

Yeast is capable of synthesising proteins from inorganic nitrogen within a very short time, the efficiency of conversion of carbohydrates to proteins ranging from 16 to 33% while a one tonne bullock synthesises hardly 1/2 kg of protein per day, the yeast cells weighing 1 tonne are reported to proliferate so rapidly as to yield 50 tonnes of proteins in the same period. A number of microorganisms are known to be suitable for producing proteins, but bacteria and yeast are generally preferred

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due to their faster growth rate and higher protein content. Food yeast is a pale yellow product with a nutty taste and can be incorporated at 5% to 10% levels in processed protein foods intended for human consumption. It has been suggested that part of the sugarcare production should be used as substrate for yeast production on a national scale. Thus even by utilizing 5% of the sugarcane grown in our country, about 1 lakh tonnes of single cell proteins could be produced to meet the complete protein requirements of at least a population of 5 millions.

Unicellular algae, *Chlorella* is another potential source of single cell proteins. They can be produced under controlled conditions to give a product with 50-60% proteins on a dry basis. The green cells of algae are capable of converting carbondioxide, water and a few mineral salts into good quality proteins using solar energy. It has been reported that upto 100 g of dried algae could be consumed and tolerated by human beings. Dried *Chlorella* can be added to green tea, soups, noodles and baked products. The cell mass composition can be varied by manipulating the growing conditions. *Chlorella pyrenoidosa* has been grown under varying conditions to give cells with proteins in the range 7-78% and fat 4.5 - 8.6%. The estimated yield of these cells could be as high as 17-40 tonnes per acre. *Scene desmus* and *Spirulina* species are also recommended for large scale production as sources of proteins.

Synthetic foods: The basic food nutrients are the proteins, carbohydrates, oils, vitamins and minerals. While minerals can be easily supplied in any synthetic diet in the form of most metabolically active forms, other nutrients are being provided largely from natural resources. Methods are now available for the chemical synthesis of vitamins (vitamin A, thiamine, riboflavin, ascorbic acid, nicotinic) and amino acids, although at higher cost of production than from natural sources. Recently, the simple hydrocarbon derivative, 1-3 butane diol available commercially, has been proved to be a suitable source of energy for animals with a caloric density of 6 per gram, a value midway between carbohydrates and fats. Since this compound is metabolised through carbohydrate pathways, it is usable interchangeably with carbohydrates as an energy source. Similar chemically synthesised substances could be tested as partial or complete ingredients of partial or complete synthetic diets for future use.

It is not a realistic proposition to envisage that man will eventually live on a handful of food or on a few pills. This is only a fallacy in view of the fact that energy requirements can never be supplied in a concentrated form though vitamins and minerals are today available in concentrated doses. The required calorie intake of 2000-3000 by an average workingman cannot be got from less than 500 g of dry matter. It is more likely that it will approach 800 g of plant manufactured starch and sugar, made so economically in the nature[33].

Recent reports indicate that by heating mixtures of amino acids in certain proportions, compounds called 'protenoids' with specific chain length can be synthesised. The possibility of fabricating proteins of desired composition has to be explored in this century. Super nutritional proteins containing high proportions of lysine, methionine and tryptophan can be custom made. On an average any L-amino acid can be synthesised at a cost of 2-8 dollars per kg.

Synthesis of chlorophyll and its use in the manufacture of phytosynthetic foods is also a possibility. By resorting to such a controlled photosynthesis one can continue to reap full benefits from the generously

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flowing and cost free sun energy. One major disadvantage in synthesising starch and fat is the higher requirement of water to the extent of 500 times more than that used by nature.

Insects as food: Insects constitute the foremost menace to man and are characterised by diverse nature, high productivity and fast multiplication. Several groups of insects have comparatively high nutritive value and are being used as food in some countries. Thus, Japanese are reported to sprinkle a finely ground powder of salted and dried cockroaches on rice as a nutritive supplement. Likewise, the Mexicans are reported to use dried eggs or larvae of water beetles as an important ingredient in cookies. Dishes prepared from crickets is a highly estimated meal in several islands of West Indies. Canned chocolate coated locusts are found on the shelves of U.S. super markets as a delicacy. Insect breeding establishments might very well become a branch of huge transforming and converting centre for food which in future may be part of every major metropolis in the globe. The tropical climate in our country is highly suited for the growth of the insects. Current food habits may be a major obstacle in utilising these food resources[29].

Waste recycling:

Disposal of wastes is becoming a major problem in advanced countries. Yet, they contain valuable nutrients that can be recovered and are too precious to be frittered away. Great promise is seen in utilising urban sewage as a medium for the production of yeast as well as algae besides breeding certain varieties of fish.

Cellulosic and woody materials can be converted into digestible foods by chemical, enzymatic or microbial methods of hydrolysis. One of the reports suggested that if the paper wastes in the

U.S. were collected and transformed by chemical methods to sugar, the caloric requirements of one third of the U.S. population could be met. Enormous quantities of cellulosic wastes such as bagasse, paper wastes, and dry foliage which are potential sources of sugar are produced in the country. A systematic approach should, therefore, be in the country. A systematic approach should, therefore, be made to assess the availability, and the potential of these raw materials as part of the future programmes of food development.

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TABLE 1: Population, rate of growth in 1971 and 2000 A.D.

Population	1971[a] (millions)	Average annual rate[a] of growth in 1961-71 (%)	2000 A.D.** (estimated) (millions)
Total	547	2,466	969
Urban population	109 (19.87)*	3.783	228.581 (22.5)*
Rural population	438 (80.13)*	2.178	740.419
Population employed in agriculture (cultivation + agricultural labourers) (%)	68.63	-	-

(Ratio of males and females is 1000:932)

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*Percentage of total population.

**Calculated from average population growth of 2,466%

[a] Census of India - 1971, Paper 1 of 1971 - Supplement Government of India, 1971, p.4, 49.

TABLE 2: Area and production of food materials

Commodity	[1]Area in 1971-72 (million ha)	[1]Production in 1971-72 (million tonnes)	Average[2] yield in 1970-71 (kg./ha)	Required[**] production in 2000 A.D. (million tonnes)	Gap[3] to be filled in 2000 A.D. (million tonnes)
Foodgrains:					
Rice	37.334	42.735	1134.0	76.509	33.774
Wheat	19.163	26.477	1299.0	47.403	20.926
Jowar	16.900	7.753	470.0	13.880	6.127
Maize	5.637	5.026	1270.0	8.996	3.970
Bajra	11.769	5.357	620.0	9.589	3.213
Barley	2.432	2.501	1103.0	4.475	1.974
Ragi	2.400	2.167	870.0	3.879	1.712
Small millets	4.513	1.582	389.0	2.832	1.250
Total cereals	100.150	93.598	-	167.575	73.977
Pulses	22.174	11.057	516.0	24.403	13.346
tal Foodgrains	122.224	104.656	-	191.978	87.322
Oilseeds:					
Groundnut (kernels)*	7.510	4.511*	832.0	20.379	16.879
Sesame	2.392	0.450	232.0	2.028	1.578
Rape/mustard	3.614	1.433	589.0	6.476	5.043
Cottonseed	7.800	2.363	302.0	10.676	8.313
Safflower	0.598	0.131	N.A.	0.587	0.456
Niger seed	0.494	0.116	N.A.	0.524	0.408
tal Oilseeds	22.408	9.003	-	40.670	31.667
Tuber crops:					
Potato	0.492	4.826	8006.0[a]	(35.3	(24.3
Tapioca	0.354	6.026	N.A.	(	(
Sugar, Gur:					
Sugarcane	2.390	113.578	-	-	-
Gur	-	11.626	-	20.595	9.969
Sugar	-	3.113+	-	5.514	2.406

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[1] Directorate of Economics and Statistics.

[2] Indian Agriculture in Brief, Directorate of Economics & Statistics, Ministry of Agriculture, 1971, 11, Edn., 58.

+Bull. Fd. Statistics, 1973, p.11.

[a] Fig. of 1969-70.

*On the basis of 73% edible matter in pods.

**The proportion of different crops in the production of 1971-72 has been maintained while projecting the figures for individual crops in 2000 A.D. for a population of 969 millions.

[3] The percentage increase works out to about 179 for cereals, 220 for pulses.

TABLE 3: Production and availability of food materials in 1971-72

Commodity	Production in 1971-72 (million tonnes)	Availability in 1971-72	
		Total (million tonnes)	Per capita (g/day)
Cereals	93.598	79.560[a]	398
Pulses	11.057	9.400[a]	47
Oilseeds	9.001	7.550[a]	-
		(2.416)[c]	12
Potato	4.920	3.690[b]	18
Tapioca	5.938	4.458[b]	21
Fruits/vegetables	20.000	15.000[b]	75
Gur	11.626	11.626)	73
Sugar	3.113	3.113)	

[a] Calculated on the basis of 8% for seed and feed + 7% for loss (a total of 15%) and for the whole population.

[b] Calculated on the basis of about 25% losses.

[c] "Oil" calculated on the basis of 40% oil content and that 80% of oilseeds are extracted for oil.

TABLE 4: Balanced diets for man and woman (nutr.Advisory Group 1968)*

Diet Component	Man[a] (g/day)	Woman[a] (g/day)	Average taken for calculation g/day
Cereals	475	350	412
Pulses	65	55	60
Green leafy vegetables	125	125	125
Other vegetables	25	75	50
Roots and tubers	100	75	87
Fruits	30	30	30
Milk	100	100	100
Fat and Oils	40	40	40
Meat and Fish	30	30	30
Eggs	30	30	30
Sugar and Jaggery	40	30	35

*C.Gopalan & B.S. Narasinga Rao, Dietary Allowances for Indians N.I.N., ICMR, Hyderabad, 1971, p.87, 88;

[a] Values taken for adults engaged in "moderate work".

[1] The allowances for adults engaged in "heavy work" and for children, adolescent boys and girls and nursing/pregnant mother are special but have not been considered individually.

TABLE 5: Requirements of food materials and production needed to meet the demands of 969 million population in 2000 A.D.

Commodity	Requirements according to the level of availability in 1971-72 (million tonnes).	Production needed according to 1971-72 level of availability in 2000 A.D. (million tonnes)	Requirements according to Nutr. Adv. Bd. (1968) allowances* (million tonnes)	Production needed according to Nutr. Adv. Board (1968) allowances (million tonnes)
Cereals	140.953	162.096[a]	145.718	167.575[a]
Pulses	16.651	19.149[a]	21.220	24.403[a]
Oils	4.279	4.279[a] (10.697)[c]	14.147	16.268[a] (40.670)[c]
Potato	6.536	8.170[b]	30.770	35.3[b]
Tapioca	7.897	9.871[b]		
Fruit/Vegetables	26.572	33.215	10.610	13.262[b]
Gur	20.595	20.595	12.378	-
Sugar	5.514	5.514		-

[a] Adding 15% for seed, feed and wastage.

[b] Adding 25% to account for losses.

[c] As Oilseeds.

*Calculated on the basis of normal adults.

TABLE 6: Production, availability and requirements of animal foods.

Commodity	Production 1970-71 (000 tonnes)	Availability* per capita 1970-71 (g/day)	Requirements in 2000 A.D.		
			As per 1970-71 level of availability (000 tonnes).	According to Nutr. Adv.Bd. allowance, 1968 (000 tonnes)	Gap (%) to be filled in 2000 A.
Milk[b]	2,400	120.0	42,515.0	88,421[c]	368
Meat[b]	518	2.5	918.0	2,306[d]	445
Poultry meat[b]	69	0.3	122.0	276[d]	400
Eggs[b]	78	0.4	138.0	10,610	1365
Fish[a]	1,746	8.7	3,100.0	8,028[d]	459

*Calculated on the basis of a population of 547 millions.

[a] India 1973, p.221;

[b] FAO Production Yearbook, Rome, 1970, p.55, 363,408.

[c] Milk requirement has been calculated on the basis of *per capita* allowance of 250 g/day.

[d] Since the Nutr.Adv.Bd. 1968, recommends 30 g/day/person of meat + fish cumulatively, the total requirements have been calculated according to the proportion of meat, poultry meat and fish in the production of 1970-71.

TABLE 7: Yield under national demonstration schemes Kharif 1965*.

Crop	Average yield (kg/ha)	Highest yield (kg/ha)	All India average yield (kg/ha)	Yield to be achieved to reach the production target in 2000 A.D.** (kg/ha)
Rice	4684	8695	1610	2050
Maize	4077	6192	993	1595
Jowar	2626	6561	545	826
Bajra	2940	5175	381	814
Ragi	4289	5202	791	618
Wheat	3319	6800	-	2473

[*] M.S. Swaminathan, Indian Farming, 1966, 16(6), 69.

[**] By considering the same area as in 1971-72(vide Table 2).

TABLE 8: Relative yields of different crops under non-irrigated and irrigated conditions.

Crop	Unirrigated	Irrigated
heat* (Sonora-64) (kg/ha)	930	4780
engal gram[a] (lb/acre)	600	1800
ur[a] (lb/acre)	500	1600
roundnut[a] (lb/acre)	1300	3000

[*] Report of Irrigation Commission, 1972, Vol.1, p.111.

[a] Handbook of Agriculture, ICAR, 1966.

TABLE 9: Average milling yields of rice from paddy in rice mills (Data from CFTRI)

Type of mill	Total raw rice(%)	Total par-boiled rice (%)
Modern rubber roller mills	72.5	73.5
Conventional disc sheller mills	71.0	73.0
Engelberg type huller mills	69.0	72.0
Old huller mills	65.0	68.0

TABLE 10: Relative cost of animal and plant proteins.

Food		Price - Rs./kg of protein
Chicken	..	60.0
Mutton	..	50.0
Eggs	..	50.0
Milk	..	45.0
Fish	..	40.0
Bengal gram dal	..	13.0
Groundnut flour	..	5.0
Sesame flour	..	5.0
Cottonseed flour	..	5.0

TABLE 11: Production of fish achieved with present methods of fish culture.

Types of fish culture		Production per acre per year (kg)
Fresh water ponds:		
Unfertilised	...	25 - 500
Fertilized	...	75 - 750
Fertilized and prepared feed added		1000 - 2500
Brackish water ponds	...	200 - 1000
Flowing water trout	...	5000 -35000
Carp/cat fish	...	500,000

E.Evan Brown, Food Technol., 1973, 27 (12), 60.

TABLE 12: Availability and uses of oilcakes (tonnes)

Crop	Quantity available	Export	Animal feeding and manuring	Protein source for human consumption.	Protein equivalent.
oundnut	180,000	700,000	550,000	550,000	275,000
same	200,000	6,000	97,000	97,000	38,800
tton	2,000,000	250,000	875,000	875,000	350,000
yabean	27,000	-	-	22,000	9,680
n flower	30,000	-	-	30,000	6,000
fflower	50,760	-	-	25,000	7,000
TAL:	4,157,760	956,000	1,547,000	1,599,000	606,480

S.S. Rajan, Seminar on Nutritious Foods for Meeting
Social Objectives, Fd. & Nutr. Bd. Oil Technol.
Assn. & AFST, India, 12 & 13, March
New Delhi, 1973, 39.

COMMUNICATIONS

India Futures 1975 - 1985 - 2000

COMMUNICATIONS

by

J.G. Krishnayya*

Rather than give an extended verbal introduction to the subject of our Working Group, I would like to put together here a few tabular statements which provide a frame of reference for our thinking. Of course it is understood that all information processes are subsumed in 'Communications'. We also take as commonly shared that model of human communication which postulates the existence of an 'image' of the outside world in each participant. This constitutes the cumulative and structured result of previous information inputs. Fresh data is processed in the light of the biasses of this structuring of the information-image of the external world. An exact analogue of this 'image' is postulated for all living systems, including corporate entities, organisations, government departments, political parties, and even nations.

1. As a basic framework for our analysis of the future let us use the diagram below. Under Aspects we have listed some of the issues that underlie the use of each technology and mode of communication.

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*Convenor, Technical Sub-Group on Communication of the NCST Panel on Futurology.

.../contd.

Types of Communication Aspects	One to one	One to Many	Many to one	Many to Many
Cost				
Reliability				
Speed				
Accuracy				
Security				
Impact				
Time Span (half life)				
Size of message				
Value				
Coding protocol				
Skill required (learning time)				
Equality of Accessibility				
Other Technological Factors.				

It is clear right away that many of the most important issues in communications, including information processing, are political ones, because they concern changes in the power-position of a person or persons relative to others in a society.

2. The manner in which these changes will occur and the problems of resolving them are exemplified in the diagram below (which is adapted from the 1971 Conference Borad Paper of John McHale, Director of the Centre for Integrative Studies at S.U.N.Y. Binghampton, N.Y., USA .

..../contd.

Changes in Information Process

Changes in nature of power

Changes in nature of Resources.

Individual changes in Perception, Attitudes Values and Capabilities.

Individual

new modes of:

Thought	Work	Interactions
Education	Life style	Access to power
Amplification	Productivity	PoliticalAction

Institutional Impacts

Business Administration Politics Education

Inter-Institutional

Law Governance Economic Management Social Groupings

Global (Overall) impacts

Homogeneity/Heterogeneity

Income Distribution

Power Distribution

Suggestions for Working Group

Organic changes in Technology and Environment of Information Processing and Communications which have brought us to the complexities of today can be characterised as:

Exponential Increase in volume of information flow

Time and distance a small constraint upon Communications (especially communications on, from or by a wealthy entity).

- Global shrinkage
- Decrease in the 'time-cushion' between sociotechnical changes, their impact and consequences
- Increase in dependence upon information and communications services.
- Growth of complexity in the linkages within government and its subordinate agencies providing various supporting services essential to society.
- Increased interdependence of previously autonomous institutions and services due to feedback required from shared information sources.
- Radical conceptual changes induced by increased information and communications.

This list is adequate to suggest that reactive, if not proactive steps are urgently needed to cope with the societal stresses induced by these changes.

3.2 Of course Communications and Information Technology also offer solutions and great societal benefits if we know what is available and can evaluate it correctly in our economic, social and historical context. For this the table below may be useful.

.../contd.

COMMUNICATION TECHNOLOGY			INFORMATION TECHNOLOGY		
One/One	One/Many	Year	Computer Costs.	Computer Speed	Computer Development
Telegraph & Telephone provide certain individuals with direct access to a system of personalised, instantaneous, local communication with individual control over content.	Mechanical improvements in techniques of printing result in a flood of printed materials, books, newspapers, periodicals. Radio provides efficient low cost medium for aural communication. Privacy of such communication is not possible.	1950	About $300 for 1 million operations	About 10 minutes for 1 million operations	Cybernetic theory Information theory, 1st commercial computer (UNIVAC), FORTRAN (1955)
Telephone networks and equipment become more widespread & complex; direct distance dialling, picturephone, dataphone, tele-xerox, telefassimile services available.	Radio variety and low cost low power transistors increases choice, landline links provide high quality network services.	1960	About $0,75 for 1 million operations	About seconds for 1 million operations	2nd generation computers, High speed printer, ALGOL, COBOL languages. 1st time-sharing services (computer utility)

.../contd.

One/One	One/Many	Year	Cost	Speed	Developments
ncreased use of private acsimile services, telex or business purposes, dapters for digital use f telephone channels by eleprinters. Ordinary ail remains the most mportant channel for ommunication for indi-iduals, businesses and rganisations.	New entertainment technologies such as the cassette tape recorder found suitable for disseminating aural information.	1965	About 25 cents for 1 million operations	About 3 Sec. for 1 million operations.	Research on Text and picture-handling by computer. 3rd generation computers. Time sharing becomes commercial.
lectronic switching nables intercontinental irect dialling. Tax rovisions and pricing olicy of public communi-ations utilities become ajor public/political ssue. Satellite links or international ommunications.	Videotape and videodisc equipment economically feasible for educational mass use. Satellite rebroadcast of TV/ratio signals tested. (Many to one aspects of satellite-collected data also receive attention).	1970	About 6 Cents (50 nP) for 1 million Operations.	About 1 Sec. for 1 million operations.	Fourth generation (Medium scale integration) computers. Low cost on-line input devices:- teletype, visual terminal, low cost disc and cassette tape storage, mini-computers grow from "mini" to "midi", move from scientific laboratories to offices.

..../contd.

One/One	One/Many	Year	Cost	Speed	Developments
Satellite links intranational and international become widely used. Provide broad band service.	Videotape and video disc and subscriber cable-TV are economically feasible in densely populated areas. Laser printing and computer typesetting speed up publication times.	1975	About 1 Cent for 1 million operations.	About ½ sec. for 1 million operations.	Marriage of midicomputers and communications to form distributed intelligence networks. Eclipse of the punched card. Data is portable on diskotes, cassettes. Unit price of complete computer system down to $30,000 (Rs.240,000) including processors, disc storage and input-output. Hand/Desk calculators are indistinguishable from portable microcomputers.
Access to flexible fast one to ohe communication devices defines a class of society which becomes increasingly closed, dominant and remote from the rest. Mail services need redesign and fresh pricing strategies.	More people learn of events (facts) from verbal, visual mass media or word of mouth (rumour) than from (accountable) printed media. Possible source of danger to stability.	Next decade	Trend may continue for another 15 years.		Computers provide increasingly flexible, convenient complementary extension of human intelligence. (Also threat of using large computers to amass data in way that threatens independence of societal subunits & individuals).

4. The Working group may like to take for detailed study the opportunities/Dangers that suggest themselves in each Aspect of the four modes of communication presented in the Table in Paragraph 1. From subsequent discussions we may be able to evolve a set of societal priorities for action. It is relevant here to note that whereas the services but not the technology of 'communications' is under government control in India, in computer technology almost the exact opposite situation exists: because of control over imports and licensing, government controls the availability of technology - but not the services that reach users.

RURAL DEVELOPMENT

RURAL DEVELOPMENT IN INDIA DIAGNOSIS & DESIGN

Points for Discussion

'A'

DIAGNOSIS

1. Impact of development policy on country-side; Destruction of the self-contained and structurally autonomous village society and of its life style and quality of life.

2. Drainage of resources and skills from rural to urban areas.

3. Growing incapacity of agriculture to sustain a rising population, leading to exodus of rural poor to urban areas,

4. Serious regional imbalances in respect of 1, 2, 3 thus making parts of the country highly prosperous and resource-saturated and given to high consumption standards while leaving the rest panperized and resource-scarce.

5. Convergance and slow developments into a basic cleavage in our social structure - between the middle class elite and the lower class masses.

6. Corresponding political and bureaucratic centralisation.

RESULTS

1. Rural-urban dichotomy.

2. Regional disparities.

3. Class cleavages.

4. Immizerisation of large sections of rural society.

5. Outflow of rural poor into the cities.

6. Tensions and violence in cities.

7. Authoritarian politics.

8. A scenario of disintegration and chaos.

'B'

DESIGN OPTION AN ALTERNATIVE

1. End to dichotomy between rural and urban, towards the integrated model.

2. Arrest of outflow to metropolitan areas.

3. Instead, growth of clusters of human settlements, built around medium sized towns.

4. Supplementing agriculture employment by growth of diffuse industrial structures reaching out in and around villages and a wide dispersal of skills and occupations.

5. Reduction of regional and intra-regional disparities, thus making for a more quick spread of opportunities throughout the country.

6. Reduction of class cleavanges and of elite mass gaps.

7. A participant, decentralized polity.

'C'

Transition Strategies (From 'A' to 'B')

(1975 - 2000 A.D.)

1. Reversing rural to urban outflow of resources by augmenting infra-structures and in and around rural areas ('clusters' as above).

2. Territorial reconstruction of regions, States, Localities with a view of affecting a better distribution of resource and economy and political power.

3. Appropriate policies of location, of skill, of resource complementarities.

4. Appropriate technological mixes for an agro-industrial culture of development (issue of size, economies of scale, value optimization.

5. Appropriate educational policies (issue of location, length of education, extent of formalisation, opportunities for renewal).

6. Institution building for narrowing 'gaps' (spatial, social class, political) for massing towards a decentralized and participants society/economy/polity).

7. Relevant ethic of consumption (and corresponding production priorities).

8. Policies of minima and maxima, and of transfers between classes.

9. Ecological and resource preservation policies.

10. Relevant social sciences and technological resources.

DR. RAJNI KOTHARI

Institutional Arrangements for Financing Rural Development through 2000 A.D. - A perspective

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By B. Venkata Rao*

The Group may find discussion on the following aspects useful in identifying the areas requiring further research and study and in broadly understanding the dimension of the problem.

1. Earlier and current attempts at rural development - its goals content, arrangements for implementation and results; the role of financing institutions.

2. The new concept of 'Rural Development' - its goals and dimensions, and its complementarity to the development effort in the industrial/urban sectors. The central issues in 'Rural Development' as it is now understood.

3. Comprehensive approach to 'Rural Development' - the various components will have to fit into each other to promote coordinated development, and better living conditions in the rural sector.

4. Components of 'Rural Development' programme will have to be indicated and the goals to be attained under each component will have to be known. But the basic component will have to be agricultural development. When this is firmly under way, the process spreads to other activities.

5. Once components are identified, and goals set for each, the technologies to be employed and the educational/training processes to be adopted will have to be chosen and the organizational/financial implications of these will have to be assessed. Each component will have

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*Shri Rao, Director in Agricultural Refinance Corporation has been permitted to be on the Group in his individual capacity.

to be subdivided and projected to assess the credit etc. needs in the 2/3 decades.

6. At present, financing institutions are equipped to assist certain activities that fall under the head of 'Rural Development'. They suffer from legal, structural, organisational and financial constraints, is assisting all activities coming under Rural Development. These constraints will have to be identified. Some of the components of Rural Development are financed by Governments. In that case coordination at all levels planning, implementation and financing between financing institutions and Governments become important.

7. National priorities through 2000 A.D. in the sphere of 'Rural Development' will have to be spelt out. This will take into account population control, agricultural productivity, rural industries, employment, health and nutrition, literacy, regional imbalances, weaker sections, etc. The machinery designed for the purpose will have to identify the areas where the projects have to be launched on a priority basis. Financing arrangements have to be organized to dovetail with the plan. Criteria will have to be indicated to determine the activities to be financed by institutions and those to be financed by Governments.

8. This calls for the existing financing institutions equipping themselves in various ways, including acquiring expertise and skills and extending their organizations for financing rural development projects in a comprehensive way. Legal and other difficulties will have to be got over. It also calls for examination of the need for redesigning some existing institutions or setting up altogether new institutions at appropriate levels. This will have to be dovetailed with the national scheme of priorities.

9. The choice of the type of organization designed for implementing rural development projects assumes importance not only from the point of view of efficient implementation, but also from the point of view of raising resources. Resources for Rural Development will have to come mainly from surpluses generated by agricultural component of the projects. Only a sound agricultural base will make the projects self-sustaining.

Initial boost, however, may come from the World Bank/IDA, provided the projects are formulated on a sound basis and financial institutions are suitably developed to attract resources and the implementation and evaluation arrangements are likewise efficient and satisfactory. Suitable criteria will have to be indicated towards this end. For instance, among the criteria for Rural Development Projects, the following are indicated as important:

a) the benefits of the projects should reach a large number of low income groups in the rural areas;

b) the projects should provide a balance between production and welfare components;

c) they should provide for local participation and for making full use of locally available materials and resources; and

d) should be economically viable and reflect low cost per person relative to overall benefits.

Impact of Rural Electrification on life style and other socio-economic features in Rural India.

S.V.R. Rao,
Management Specialist,
Rural Electrification
Corporation.

The importance of electricity as a physical infrastructure for economic development of a country like India needs no emphasis. In the words of late Pandit Nehru "Power is the foundation of all development today. Just as the industrial revolution of 18th century led to the machine age, the 20th century is now leading to the Power age". India being predominantly agriculture and rural, any progressive measure taken up to augment agricultural production will lead to the country's economic development. The wide use of electricity increases agricultural and industrial production and this raises the standard of living. The Chairman, REC observes" with water, seed and fertilizer, the electricity is basic to agricultural growth and with raw material, skill and technology it is essential for the development of small and big industry. The wheels of commerce, speeded by development, run on electricity. Finally, planned electrification can make all the differences between lopsided urbanisation and balanced growth of village, town and city". Prof. Sonachalam, in his report points "electricity not only promotes manufacture and helps agriculture thereby augmenting material output but also provides cheap and clean public, commercial and domestic lighting. It ushers in a social and psychological revolution by its very ubiquitous presence, not to mention the knowledge and intellectual illumination through the wide use of the radio".

In India, the main source of living is agriculture. The Indian farmer has mostly been the victims of the vagaries of mansoon. Assumed irrigation through rural electrification enable him to irrigate the land, but also provides to the villager a major input for development. By energising pumsets, the farmer gets plenty of water for irrigation so he could have multiple cropping instead of single one. Moreover, with the introduction of electricity rural industries could come up providing employment to the unemployed and or underemployed villager.

Rural electrification in the past has proved that not only economic benefits are achieved but also many times far-reaching social benefits which are not measurable in terms of money. Though our rural population is economically backward, any improvement in the social life would automatically raise the standard of living of the rural mass. Thus "rural electrification is considered in some matters a social service rather than an economic overhead. In a predominantly agricultural country like India, rural electrification has district role in transforming the economic scene of the country wide and revolutioning techniques of agricultural production" observes the Punjab study on rural electrification by the NCAER.

The NCAER Study on Rural Electrification in Punjab brought out that the older the age of electrification higher was the percentage of gross revenue to the capital invested. On an average, a pumpset/tube user saved 354 bullock labour days per crop year and in terms of money, this worked out to Rs.712 per crop year. In the case of human labour, a farmer using pumpset/tubewe in Punjab saved about 357 days of family or hired labour valued at Rs.1,107.

The NCAER study on Rural Electrification in Kerala revealed that the average capital cost of a pumpset operated by electricity worked out to be Rs.2,156 whereas the average capital cost of a pumpset operated by diesel oil is Rs.2,757. Analysis of the data on the average cost of power, fuels and labour per hectare for the different methods of irrigation by the size of cultivated area of the user showed that the average power cost has comparatively economical and profitable for the farmer who operated a pumpset.

The Madras study by Prof. Sonachalam observed the following points. Starting with 8 pumpsets in 1933-34, it rose 250,000 in 1965 as compared with 200,000 in the rest of the Indian Unions. In the year 1963-64, the total consumption of electricity for irrigation in India was 1,187 million units of which the share of Madras was 559 million units amounting to 47.1 per cent. With the result, the actual receipts from consumers of electricity in the agricultural sector amounted to Rs.491 lakh. Installation of electric pumpsets has affected substantial saving in the farm expenses on irrigation. If diesel motors had been used instead of electric motors, additional expenditure that would have been involved was estimated at Rs.2.8 crores. If bullock power were used instead, additional expenditure would have soared upto Rs.10.8 crores. The cost of irrigation with bullock power worked out to Rs.200 per acre while that of diesel pumpset to Rs.83 per acre and electricity to Rs. 56 per acre. It also helped replacing dry and light yielding crops by wet and heavy yielding varieties.

The P.E.O. Study on Rural Electrification states that the cultivators constitute by far, the highest proportion (44%) of the electricity consumers followed by traders and Shop-keepers (27%). According to the study electric pumpsets were installed predominantly by farmers with large size holdings and thus indicate conclusively the benefits going to the larger farmers. The average area brought under new crops as a result of electric pumping was 3.81 acres per household, which worked out to 15.8% of the cultivated area of the households. Cereals and pulse crops were newly introduced by the largest proportion (37.4%) of the relevant households. About 27% of the sample respondents reported the release of some family labour as a result of switching over to electric lift irrigation and 53 per cent of bullock labour. The economy in bullock labour is valued more by the cultivators, On an average 36 bullocks labour days were estimated to have been released per month per household through switching over to electric lift irrigation. The largest proportion(45%) of benefiting households reported the impact on cropping as the main benefit, particularly starting increase in the area under certain crops (31%). A little over one-fourth (27%) of the responses suggested financial benefits resulting either from reduced cost of irrigation or from increased agricultural returns on receipts of sale of water and another one fourth (27%) indicated improvement in the quality of irrigation.

In the Industrial Sector, the Punjab study stated that 68 per cent of the industrial units interviewed own their existence to electricity. The remaining units reported about the saving of Kerosene oil, high speed diesel oil and light diesel oil as a result of which, the net income of a unit increased by Rs. 1,602 per annum after electrification. The increase in saving in the small villages is more glaring than the big villages.

Kerala study observed than the cost of Power incurred by a flour mill using electricity was only Rs. 656 as compared to Rs. 811 for a mill not using electricity. Rice mill using electricity reported the cost of power at Rs. 723 (average) while a mill not using electricity as Rs.1623 (average). The cost of operation of a flour mill using electricity (10 HP electric motor) amounted to Rs.1604 whereas for a flour mill using diesel oil (10 HP diesel engine) the cost worked out to Rs.2842. This cost includes wages, cost of power, cost of operation and of preventing maintenance.

Prof. Sonachalam in his report on Madras State brought out the trend in the growth of small scale industrial units and indicated that from an average of less than 30 units set up per annum during the quinquennium ending 1934-35, it rose to more than 300 units during the Second and Third plan periods. The annual average investment in rural industries worked out to Rs.106 lakhs during the 35 years. The districts of Madras, Salam, and Coimbatore emerged as leading among the districts both in numbers and capital invested in rural industries accounting for more than 50% in regard to the capital. The large clustering of the small scale industries in these districts is an evidence of the spread effects. The increase in output of commercial crops in the past 30 years stimulated by the industrial development achieved during the electricity era is to be reckoned as an indirect benefit of electricity. The value of such additional output viz. 94,580 bales of cotton, 519470 tons of sugarcane, 457330 tons of oil seeds was estimated at Rs.51.8 crore per annum. Extension of cultivation particularly for the commercial crop which formed the raw material base for industrial development was estimated to be of the order or 8.45 lakh per annum than providing employment opportunities The transport thus of the additional output worked out to 7.45 million ton miles leading to corresponding increase in lorry and bullock cart transport.

As for rural industrial development after the introduction of electricity, the P.E.O. report pointed that taking all the industries together it appears that more than three further of the industrial units were started after electrification. Only 12 out of 87 relevant househol reported release or reduced requirement of family labour and out of these 12, eight maintained that the released lab was being fully utilised. The average number of hired persons employed whole time decreased after electrification from 4.0 to 3.6 persons per unit.

Increase in the working time consequent on electrification was reported to be 2.17 hours per responden reporting increase. 71% of these respondents had increased their working hours by working late in the evening, 4% both later in evening and early in the morning and 1.5% by worki longer hours during the day only.

So far, we have seen the quantitative benefits or in other words the economic changes that took place since the introduction of electricity in the rural areas. Now we will discuss the qualitative aspect or social changes that are brought to the rural mass by using electricity to better life equivalent to their counter parts in the urban areas.

In addition to the use of electricity for lighting, the domestic users turned toradios, fans and ironing. The saving in kerosene oil worked out to of 43.63 litres per annum for a domestic users. The extra working hours gained by the introduction of electricity, were gainfully spent in weaving, poultry keeping, household industries like pottery, mat making, carpentary, etc. To people, the time for reading increased by .83 hours per day, the people experienced better sense of security and the chances of fire were reduced considerably. For commercial establishments, the benefits worked out to Rs.532 per annum. In the social side, people could find time to participate in the Panchayat Ghar activities, cooperative institutions and Mahila Mandals. Also, electricity added to the availability of medical facilities during late hours in the night. For the youth in several areas, the introduction of electricity helped to remain in villages by providing employment and this reduced the influx of migration to urban areas to a certain extent. Finally, electricity played an indirect role to reduce population and adopt family planning measures by providing entertainment through pictures and radios.

The Kerala study revealed that with the same average number of working hours per day for the commercial establishments using electricity and not using electricity, the average income in 1967-68 proved a big difference, favourable to the establishments using electricity even though average cost of power was slightly more than the average cost of oil. In the case of domestic users also, the cost of power was relatively higher than that of oil but the intangible benefits of better living, better security conveniences would not be measured in monetary terms.

Prof. Sonachalam's report requiring to UN report view "the extent of power development in a country provides one of the principal means of estimating its economic prosperity and the standard of the people". The trend towards the dispersal of large scale industrial establishments becoming increasingly evident and the flourishing of small scale industries throughout the length and breadth of the country ushering in our era of "urbanisation" are obvious social benefits. With the advent of electricity, homes are becoming brighter, cleaner and more healthy. Much more than the improvement in physical appearance, electricity is working as a silent and powerful engine towards a psychological and technological revolution. Domestic and community radios induce an intellectual stimulation. The outlook and attitudes of rural Madras are definitely and rapidly going through a sea-change. These effects though they defy description in concrete terms, are none-the less most significant. The very fact that the demand for electricity in all sectors and form all sections of the population is racing ahead of even the rate of growth of electricity supply in India, testifies abundantly to the phenomenal change in social and economic attitudes already accomplished.

The P.E.O. report also emphasised the fact that the people had increased the reading habit with the introduction of electricity in the rural areas. Of the sample respondents, 41 per cent held that electrification made the village life more attractive to the educated youth. Also, it induced the doctors, teachers and entrepreneurs to come to the rural areas to serve the people. About 94 per cent of the respondents claimed that with electric street lights, better conditions of security prevailed in the villages. Also a good proportion of the villagers agreed that the chances of fire were lower after electrification.

To conclude, rural electrification brings a welcome change in the mode of life in rural areas. Like in urban areas, the rural folk, could also get in touch with the world affairs leave alone the better standard of life in villages with all the modern amenities and not to go to cities for better livelihood. This enriches the rural mob both in economic as well as in the social life erasing ignorance of modern technology in all the fields. The villagers can lead a happy, peaceful, clean and bright life in the villages and thus bring prosperity to the nation. To quote, late John. F. Kennedy, "Revolutionary increase in the electrification of American farms occured in almost a decade. What we have done can be done in a great many countries with organisation, arrangement and with stimulation from both their national Governments and their local commenities".

INDUSTRIAL & RURAL DEVELOPMENT IN 2000 AD

Some Tentative Points

By

Mr. D.R. Pendse*

1. Central economic issue: Removing Rural Poverty; and improving rural standard of living. Rural development should be envisaged as a means of expeditiously achieving this object.

2. Being realistic: The minimum to be achieved is that everyone even in the most backward rural areas should have an income potential or an employment opportunity, at least to buy a given basket of goods and services, which is the poverty line basket.

   Need to define the contents of the basket right now. This will be the minimum. Anything above it has to be aspired.

3. Two obvious policy-planks:

   (A) Stop the increase in population.

   Importance not realised of population policy.
   Carrot and stick approach.

   (B) Improve the lot of those already born.
   Policies need to be considered for this. See below:

4. First, reducing pressure on land.

   (i) Structural change normal, phenomena.
   In India, a couple of limitations; but still valid.

   (ii) Will actually improve efficiency (cause, also effect).

5. Already a pressure of migration to cities.
   The above will aggravate this.
   That will be disastrous. Hence etc.

6. Two policy options: (i) Wage-employment; (ii) Self-employment. Both indicate need to industrialise:
   (i) above - medium, large, small
   (ii) above - cottage, services, tertiary
   Nehru's 'Real Progress must ultimately depend on industrialisation'.

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TECHNOLOGY FOR RURAL INDIA

Dr. M. S. Iyengar*

When man builds a city, he builds water-proof houses and paves streets so that they will be water-proof. He may water-proof 50-60% of the areas of the city. Consequently, cities have more fog than the open space around them and it rains about 10% more in cities than in surrounding areas. Man is continuously changing the climate unintentionally.

Rajasthan in India is today a 250,000 square miles of desert, but in the past, it was occupied by a vast agricultural empire. The Harappans inhabited the city of Harappa. How did they maintain such a high level of agriculture in what is now a desert? Professor Reid Bryson, head of the meteorological department at the University of Wisconsin speculates that the Harappans moved into an area of grassland and started farming it.1 They got good yields and their cows had enough grass on which to graze. The Harappans flourished and their population grew the people farmed more of the area intensively. They destroyed the grass cover of the land and the wind blew dust into the area.

The dust changed the rate at which the atmosphere subsided and with this change the area became more desert-like. As the climate gets drier, any people will try a little harder to grow enough food to supply the population if the population is dense and not more mobile. This means tearing more of the surface and loosening more dust to blow into the air. Around 1500 B.C., the Harappans disappeared leaving behind the strange desert of today. Although the air above it has sufficient moisture, there is very little rain because every square mile has about five and half tons of fine dust suspended above it which prevents condensation. Looking back, we can say that the Harappans, although highly civilized, misused the land and turned it into a desert for posterity.

Impact of Industrial Revolution on India

While the Industrial Revolution might have produced "intended results" in the occidental countries, it has produced unintended results in India and the other oriental countries in that it transformed the harbingers of civilization into under-developed countries. For instance, India in 15th Century was much more developed in applying knowledge to practical human needs than the occidental countries.

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What marx and Engels had termed 'Asiatic mode of production'2 was broadly speaking a state apparatus fundamentally bureaucratic in nature that operated by a non-hereditary elite, upon the basis of a large number of relatively self-governing peasant villages, still retaining much of the tribal character with little or no division of labour as between agriculture and industry. In its simplest form the land in the village was tilled in common and the produce divided among the members. At the same time, each family also carried out as subsidiary industry, spinning and weaving. The village supported a dozen other persons like the water overseers, who distributed water for irrigation, the Brahmin who conducted the the religious services, the school master who taught the children of village, the smith and carpenter who repaired agricultural implements and the potter, the barber and the washermen. The village chose its headman who was both police and tax-gatherer in one. He was assisted by the Village Council which advised him on important issues affecting the community.

The form of exploitation essentially consisted in the collection of taxes for the centralized State or the King. The duty of the State was two-fold: organize defence of the whole area and look after the maintenance of public works like the use of water for irrigation, the development of tanks and canals and the direction of broad agricultural policy.

The duties of the self-governing communities vis-a-vis the State were the payment of taxes and the provision of labour power for public works when called upon to give it. The towns were created purposefully at nodes in the administrative network and as market centres. The system of slave did not exist at the village level. The people lived a contended and peaceful life. In the words of Needham[3], "It was a society which functioned fundamentally in a 'learned' way, the seats of power being filled by scholars, not military commanders," Central authority relied a great deal upon the 'automatic' functioning of the village communities with minimum interference in their life. These societies could not be called stagnant. In fact, as Needham says, "there was a continuous general and scientific progress but this was violently overtaken by the exponential growth of science after Renaissance in Europe." For example, the technology of cast iron, essential components of reciprocating steam engine, the mechanical cloth, the boot stirrup, gun powder, all of which had earth shaking effects in Europe were known to the ancients but caused little furore on the bureaucratic feudalism. Indeed the trend in these societies was to be away from hankering after worldly goods and materialism. At a time when Europeans were pushing out adventurously far beyond the confines of Europe, around the coast of Africa, India and South-east Asia and also the Atlantic, ushering in what an Indian historian termed the Vasco da Gama epoch, in India a number of spiritual leaders like Ramanujachar, Sankardeva were leading open revolt against the cold intellectualism of Brahamnic philosophy and the misguided faith of the Tantricists, preaching the gospel of Vaishnavism, emphasising the illusory nature of the world, and calling upon people to cast off their desires and break the trap of illusion and pin their hope to the feet of the Lord. Fifty years later, when the great Renaissance and Reformism was taking place in Europe creating the preconditions for Industrial Revolution, the poet, musician and saint, Madhavadeva in the footsteps of his master was exhorting the people through his Bargith to cast off their material aspirations. The amazing thing was this movement which had its beginning in South India spread rapidly even reaching the far North-eastern corner, despite difficulties in communicatio The Industrial Revolution caused devastation in India in several ways. India lives in its villages. The village system traditionally was built on "The domestic union of agricultural and marketing pursuits". The handloom and the spinning wheel were the pivots of the structure of the old Indian society. In Moghul times, the industrial economy, both rural and urban, was greatly prosperous. Gleaming brassware from Banaras, hand-woven shawls from Kashmir, iridescent silks from Murshidabad, muslins of Dacca, dhoties and dopattas of Ahmedabad, fabrics from double-woven colour from Poona were of world-wide renown. The Dacca muslin, 20 meter long and a meter wide, could be made to pass through a maiden's ring. It was so fine, it took six months to manufacture. India was the largest exporter of cotton goods to the whole world. With the advent of the Industrial Revolution, England exported to India machine manufactured goods and decreased its imports. In England the ruin of the old handloom weavers was accompanied by the growth of the new machine industry. But in India the ruin of the millions of artisans and craftsman was not accompanied by any alternative growth of new forms of industry. The old populous manufacturing towns, Dacca, Murshidabad (which Clive had described in 1757 to be "an extensive, populous and rich as the city of London[4]) were in a years rendered desolate. The pressure on agriculture increased. Hundreds of thousands of people who once earned a liveliho from cottage industries, were now forced to eke out a meagre living. In this way, India was transformed from being a country of combined agriculture and manufacture into an agricultural colony of the British. The old village economy based on custom and barter was transferred into an economy based on contract and money. The idyllic village communities, each forming a compact whole, producing all that it required for direct use by the community itself without taking the form of commodity and which through its simplicity of organization and economical elasticity remained untouched by the stormclouds of the political sky, was shattered completely to its foundation.

The tragedy of it all was that it was India and the other colonies that provided the much required capital for financing England's Industrial Revolution. As Brooks Adams said[5]:

"In themselves inventions are passive, many of the most important having lain dormant for centuries, waiting for a sufficient store of force to have accumulated to set them working. That store must always take the shape of money and money not hoarded, but set in motion. Before the influx of the Indian treasure and the expansion of credit which followed, no force sufficient for this purpose existed; and had Watt lived fifty years earlier he ~~k~~ and his inventions must have perished together. Possibly since the world began, no investment has ever yielded the profit reaped from the Indian plunder, because for nearly fifty years Great Britain stood without a competitor. From 1694 to Plassey (1757) the growth had been relatively slow. Between 1760 and 1815 the growth was very rapid and prodigious".

According to Brooks Adams the turning point was the battle of Plassey in 1757 which enabled the influx of Indian treasure into England.

The essence of the creation of modern wealth is the application of mechanical (instead of animal) power to the land, sea and air, and the production therefore directly or indirectly of all the goods that modern civilization needs. Modern wealth is not limited and is capable of being increased; the few not only do not have to rob the many in order to become rich but must actually share their wealth with the poor in order to remain so. This became evident only after the New Deal in the United States. It is an interesting speculation, says Governor Nehru, that if this characteristic of the modern wealth had been recovnised a century earlier, the world might have been spared the whole horrible experience of colonialism[6]. The progressive income tax would have been used to produce at home those markets in search of which the world was conquired.

Limits to Growth

The United States with its large domestic market used the new technology to transform not only the standard of life of all its inhabitants but also their whole pattern of daily living. The consumer was deliberately placed at the centre of the industrial complex and mass production techniques were used vigorously. Growth was viewed as a linear process without any upper limits. The inhabitants of

North America, about 7½ per cent of humanity, are using about half the world's yield of basic resources. By the year 2,000 they will, if permitted, use all of them.

The all-consuming lust for growth is being followed by the other countries as well. This has already led to a situation where 20 per cent of the world's population consumes 80 per cent of the natural resources of the whole globe and produces about 90 per cent of the world's wastes and pollution.

Supposing, 80 per cent of the world's population attains the same industrial stature as the 20 per cent affluent world, would the resources of our planet earth be adequate? If every country becomes a consumer-based country like the United States, what would the world of cornucopia be like? Vance Packard pictures the city of the future as comprising of buildings made by Papier Mashe which could be torn down and rebuilt annually. The motor cars would be made of low density plastics and would develop fatigue and begin to melt if driven more than 4,000 miles. Factories would be located on the edge of a cliff and if the supply exceeds the demand, the output of the refrigerator or other products would simply be dropped out of sight in the grave years without having to pass through the market. It would be a taboo to use an appliance for more than two years and the push button super market would have receptacles with slogans like "throw your watches here" or "throw your transistors here". Technology would be continuously mobilized to develop products like nine-button toasters which make it possible to obtain a piece of toast in different shades and mechanical martini stirring spoons which relieve theperson from the labour of twisting his waist.

Should the developing countries, like India follow this path of development? Is there any limit to satisfying the psychological needs of men? Can the affluent countries themselves continue to have unlimited exponential growth without depleting the world resources and should they be allowed to do so at the cost of the rest of the world?

Two documents recently published have tried to answer these questions. The first document published in the United Kingdom called "The Blue-Print for Survival"[8] and the second of the Club of Rome called "limits to Growth"[9]. The first document says that "The relevant information available has impressed upon us the extreme gravity of the global situation today". They foresee that if the present trends persist "life support systems on this planet" will be irreversibly disrupted, if not by the end of the century, "within the life time of our children". Governments, they say, are either refusing to face facts or are "briefing their scientists in such a way that the seriousness is played down". The Club of Rome document is even more explicit. They assert that if development continued unabated and we waited to see what will happen, there would be an uncontrollable decrease in population and capital by the year 2100. If the limit first reached was that of food production, the developing countries would suffer the major population decrease. On the other hand, if exhaustion of non-renewable resources took place first, the industrial countries would be most affected. The solution they offer to avert the course of disaster is to develop a stable world system with a self-imposed limitation to growth. The policies to be pursued are, stabilise population by setting birth rate equal to death rate by 1975, stabilise industrial capital investment after 1990 by setting the investment rate equal to the depletion rate and reduce consumption of non-renewable resources to one fourth of the 1970 value. To reduce resources depletion and pollution the economic preference of society should shift towards services of health facilities and less towards factory produced material goods.

Many critics have, however, pointed out weakness in the Club of Rome model such as an apparent failure to give proper weightage to negative feed back loops that naturally restrict growth and which rechannel resources. There are also serious doubts about the validity of the assumption made both in setting the relationship between the mathematical variables in the choice of initial conditions. Some of the critics have used the language of MIT but by making assumptions about the extent to which the capital resources will in future years be devoted to the abetment of pollution, then have shown that the feed back loop is more vicious in its effect than made out.

Whatever be the criticism, the Club of Rome document is important as a graphic presentation of the thesis that more economic growth will not solve our problems and because it is a beginning towards an understanding as to how the world system really works. The realisation that we cannot solve conflicts by continuing to cut bigger and bigger pies in the same way must lead to discussion of how to divide the pie more equitably. And indeed it is leading to such discussions as is evident from some of the recent publications. For instance Dr. Paul Ehrlich has recently discussed at length the technique that the United States and other affluent countries should adopt for development and conversion from what he calls, "cowboy economy" to a "spaceman economy" with dramatic change in the concept of "needs" - seeking as a nation freedom and growth of the individual rather than freedom of the market and growth of the economy and industry for 'more and bigger is not necessarily better"10.

The programme which Dr. Ehrlich advocates for the developing countries is to produce agricultural self-sufficiency and not industrial self-sufficiency or even extensive industrialisation. While he recognises the cultural needs of consumer goods like bicycles, refrigerator, electric light and, the like, he however feels that these countries should not develop the capacity to manufacture all these devices but obtain them from the already industrialised countries.

In order to not over-strain the life supporting system of our spaceship Earth, he advocates that under-developed countries should forego the much desired industrialization, a sacrifice much to the benefit of the over-developed countries. The latter should, therefore, be willing to be taxed to pay for the services performed by the UDCs for the life-support system. The tax could take the form of changes in the international trade system so that it strictly favoured UDCs rather than discriminating against them as the present system does.

Will the suggestion of Dr. Ehrilich be accepted by the developing countries? If not, what is the alternative?

It should be remembered that most of the developing countries have passed through prolonged periods of colonial rules. It suited colonialists to keep these countries predominantly agricultural and as has been pointed out earlier even destroy whatever industrial structure was present. It should also be remembere that the pressue on land has increased and even if improved methods of agriculture are utilized, the standard or quality of the masses would not increase appreciably. For whatever increase there is in production is more than equalised by the increase in population. It should also be remembered that the appallingly low subsistence level prevalent in the developing countries is a present day reality. The earnings of an average Swiss equals the combined average income of two Mexicans, two Ghanians, two Filippinos, four Indians and three Europeans. While by the year 2000, the United States, Japan and other affluent countries would have a per capita income of about $20,000 a vastly increased countryside for the old system of village as a unit with a balance of agriculture and industry should be reintroduced but with this difference that there would be a qualitative improvement in the techniques through the introduction of science and technology. For instance, in most of the advanced countries the urge for mass scale production has led to centralization of the means of production with its inevitable drive for increase in capacity and automation, with greater sophistication in design and techniques. What is needed in the developing countries is a sophisticated science-based scale down. A good example of it can be found in the trend of miniaturization in the electronic field. The early radio sets were large, cumbersome and costly, which only few could afford to buy, but with the advent of printed circuit and transistor and more recently integrated circuit and integrated electronic components, the receivers have become small, compact, more efficient, less costly and within reach of the common man. Such miniaturisation in productive units should also be possible. The traditional handloom which is still to be seen in some of the villages but which is not able to compete with the power-loom products could thus be improved in its scientific content to make it competitive.

Similarly, production of metals which had its origin in the countryside could be restored not in its primitive form but with the component of science for efficient mini production.

The primitive form of shelter could be replaced not by cement and concrete structures but by improved materials of construction based on agricultural waste. For instance the building walls and roof could be constructed from agricultural waste like paddy husk, ground-nut husk or paper boards by binderless process already developed in India. The designs can be such that one can construct one's house in a few hours without recourse to machines.

The drainage system also could be localised. The urban trend of collection through costly pipe lines to a central point for disposal could be replaced by local disposal not through a system which minimises on the use of water and which through fermentation recovers the gas for cooking and other purposes and the sludge for use as fertilizer. Agricultural waste, in the process of composite manufacture, could also be made to give gas for use as fuel. Power generation could also be improved through miniaturization so that the necessary power for the small communities could be generated locally through use of non-fossil fuels like sunlight or waste or wind mills.

So far India has been following in the footsteps of the developing countries and has naturally tended to concentrate the industrial centres to a few areas. What is now needed is for her to develop technologies for decentralised production in rural areas. We can learn from nature which bases all its production on sophisticated localization, be it sugar in the cane, rubber in the tree, foodgrains, fats and oils. All these are produced through miniaturization. Each tree or plant is a complete entity. The human body is yet another example where myriads of complicated life giving substances are produced in balanced fashion.

If India is to transform itself into a post-industrial society. It is necessary for it to completely change its present urban means of production. Most of the installed production units cover a whole spectrum of products which neither has the advantage of a small-scale labour intensive unit or the saving of cost of large sophisticated plants. Their installations have not significantly contributed to the improvement and quality of life of the common man. 'It is, therefore, necessary for India to scale up its productive capacity in the urban area using sophistication to the extent of automation and cybernation. It should also use the second or third generation technology and bring down the cost of production to the reach of common man. India should also use technological forecasting and set up ecologically balanced science-based industries. For instance, the trend in the advanced countries is to replace steel with laminated products or the transistor with integrated electronic component or the cathode ray tube in the TV screen with electro-luminiscent screen. Fortunately, for the developing countries the raw materials on which the modern industry are based loom less large in economic terms than the products of the Industrial Revolution. Computers after all need very little of the fast depleting copper. These should be adopted.

Conclusion

The energy crisis has forcibly demonstrated the need for technological assessment and forecasting and long-term projection in our development. India has to evolve its own strategy of development which takes into account the present day realities of rural India. Rural India can be transformed only through a new appraisal of development based on decentralised production - not for achieving economicgrowth but for improving the quality of life and human values.

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RURAL DEVELOPMENT AND INDIA'S FUTURE

A background note

Perhaps the most striking changes in post-independence India have taken place in its vast rural hinterland. While some of us living in large urban areas may think that nothing much has happened in our country, as a matter of fact the rural countryside has undergone massive changes, thanks largely to (i) development and welfare policies, (ii) penetration of the institutions of competitive politics and a network of patronage, (iii) the growth of a money economy and a wider market, and (iv) technological inputs in the form of new agricultural practices, power and irrigation, dairy farming and agro-industrial complexes. Anyone who has regularly visited the rural areas over the last twenty-five years cannot fail to notice these changes. They have infused a new reality in our rural life.

I

TENSIONS IN RURAL AREAS

At the same time, these changes have brought a lot of dislocation in traditional village society. The earlier concept of the village as a total system and a structurally autonomous and self-perpetuating entity (which was not fully true even earlier) is fast disappearing. This is due to two factors. First, the village is getting increasingly linked with the urban environment, rural-urban discontinuties are giving place to new continuities, and urban areas are getting infected by significant rural-urban migration and commuter relationships. Second, largely because of legislative and institutional steps that put an end to the jajmani system and because of new patterns of power released by adult franchise which have displaced the upper castes from positions of dominance, the higher and upper middle caste families have been moving out of the villages. In consequence, the village today consists of a population dependent more and more directly upon agriculture.

contd...

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1. In writing this I have drawn from the earlier note on "Rural Life Style" written by my colleagues Ashis Nandy and D.L. Sheth for the NCST Panel on Futurology (See Appendix-A).

Simultaneously, the centre of political power is now gradually shifting towards the low-status, but numerically preponderant, agricultural castes. In sum, the autonomy of the village system which was a function of the preponderance of sociocultural aspects of life over the economic aspect, is being supplanted by the centrality of the economic organisations of an agricultural industry. This, in turn, is leading to new tensions, e.g., between the peasant proprietor class that has both economic leverage and political power (and access to the new technology) and the landless and the small tenant farmers. That the landless include castes at the lowest rungs of the social hierarchy, including scheduled castes and semi-tribal enclaves, adds to the sharpness of the conflict.

Shifts in Power

Concomitant with these changes and indeed significantly contributing to them is the heightened role of politics in rural life. Those with economic power, linkages outside the village society, and capacity for manipulating parties and factions due to the "numbers game" have on the one hand displaced the small upper castes that traditionally hold power and on the other hand stopped the democratization process and the fruits of economic development from sipping further downwards to the lower castes. Institutional developments like the establishment of cooperatives, panchayats, educational and welfare agencies, and banking and credit have all consolidated the power of these communities and their ability to monopolize resources and positions of authority.

Impact of Technology

Technological developments have also upset earlier perceptions. First, the psychology of close man-nature relationship is gradually being replaced by other forms of attitudes towards the environment. The older relationship was traditionally maintained through a low level of technology, intimacy between man and material objects, full acceptance of the predominance of nature or environment, and the traditional, hierarchically organised, occupational structure. As a result, social status, abstractive capacities, and leisur were the privileges of a few men. With the new distance between man and material objects introduced by technological innovations, it has become possible to partly dissociate personal status from status of jobs, give a new dignity to certain occupations (particularly occupations that are economically profitable), create leisure for even the more deprived sectors of the rural population, and allow them the opportunity to indulge in abstract and symbolic-cultural activities. All this has further eroded the distinctions in life style based on caste, has created a more instrumental view of occupation, and has made the attitude towards the environment more manipulative. As all this has happened, the power of groups that have the greatest capacity for flexibility and mobility has been further consolidated.

Changes in Family

As political, economic and technological patterns have converged in this manner, the family system is also undergoing a profound change. Tension seems to accompany mobility and rise in status, differentiation of the occupational structure, and power ambitions. On the one hand, there are contrary pulls, as between the natural tendency in rural life towards nuclearization and factionalization of families leading to their partitioning, and the economic and legal compulsions for pooling land and resources, if not for anything else at least for dodging the administrator intent on implementing new laws. On the other hand, there are deeper cleavages at work: in respect of decision-making within family, role concepts, intergenerational differences, outright political conflicts. All these directly affect earlier complementarities in interpersonal relationships shaped by the three pillars of family, caste and village. These complementarities are now breaking down. This is leading to two consequences. First, the family system is gradually becoming more autonomous from the pressures traditionally exerted by village and caste systems. Secondly, the growing occupational differentiation that accompanies social change is entering the family system itself (for instance, through faster intergenerational changes in occupation) and generating new crises with which the traditional Indian family is ill-equipped to cope.

II
CHRITICAL CHOICES

In all of this the crucial dimension is the relationship between the village and the outside world, more simply between rural and urban sectors of our society. This is an issue that deserves sustained inquiry and critical choices of policy and strategy. Here is the case for futuristic thinking - and not just in the form of prognostication, which has been the usual method in futurology, but in the form of designing a desired future, based on a normative approach to the future.[2]

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[2] I have used this methodology in my Footsteps into the Future (New Delhi: Orient Longman Ltd., 1974). A shorter note, "A Note on Theory and Methodology in the Study of the Future", outlining this methodology, was written for the NCST Panel on Futurology, in January 1974.

Scenario for the Future

India has a unique opportunity of developing a social continuum in which while the romantic utopian dream of village self-sufficiency may be left behind (there should be no regret about this as such a system had very many negative features), we may also be able to avoid the scenario of huge metropoles draining the resources of the countryside in a parasitic manner. The scenario best suited to us - and to civilized life - is one in which the country is studded by a few thousand localities, each clustering around a medium-size town, sharing in its amenities and its economy in a relatively egalitarian manner, in which all strata of society gain from the benefits of modernity but avoid the ills of post-modern consumer societies that are prisoners of highly concentrated production complexes.

Integral Development

Such a scenario will involve a number of steps and not all of them in rural areas alone. Indeed, the strategy that will have to evolve will need to be integral to the development of the country as a whole - where both production and administration are decentralized to medium-sized towns and their individual hinterlands, where city growth fates are arrested from becoming grotesque, where employment opportunities in agriculture (which have some natural limits) are supplemented by employment in small and widely diffused industries, where educational institutions are located close to where the jobs are and restructured from the present emphasis on university degrees to an emphasis on widely scattered training institutions based on short duration courses for middle range technicians in various walks of life, where health facilities are not limited to the privileged, and where the economy derives its strength from the purchasing power of the great numbers of the people and not from expansion of middle class consumer industries and their 'export orientation'. Implied in such a restructuring of rural - urban and agricultural - industrial relations is a new technoeconomic model[3] for

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[3] I have developed at some length the model that developing countries ought to follow in Footsteps into the Future, op. cit., especially pp. 16-18, 57-74. In the specific context of India, see also my "Towards A New Model", The Times of India, April 22 and 24, 1972.

our society which will enable us to reach the goals set out by us in the Directive Principles of the Constitution and often elaborated since. "Rural development" must be conceived as part and parcel of this model as a whole, a model in which we talk less of rural development in our usual segmental fashion and more of development of individuals - all individuals irrespective of distinctions of locale or class. This is what all successful polities have achieved. And it is what we should aim at.

The above design will call for a lot of detailed investigations, new ways of measuring development, and the writing of policy monographs based on such investigations and such measurement. A plan for work on each of these can be drawn up after a discussion of this Note and assignments made to institutions equipped to undertake this work in the framework of normative and futuristic research.

Rajni Kothari

March 31, 1975.

Item: "LIFE STYLES IN RURAL INDIA"

By Ashis Nandy & D.L. Sheth

Not all aspects of rural life style are amenable to futuristic analysis, nor are they pertinent to the understanding of anticipated macro changes in Indian society over the next two decades. And, it is difficult to identify persons who could do scholarly work exactly in those areas that are amenable to futuristic analysis and pertinent to this society. There is another, and more fundamental, "methodological" problem too. Most important empirical studies of Indian Villages were conducted during the 1950's. Today, they are hopelessly out-dated. Large-scale structural and psychocultural changes have already taken place in rural India and scattered studies which have been done seem to challenge the earlier concepts of the village as a total system and as a self-perpetuating, structurally autonomous, entity. These changes have taken place mainly in consequence of the new political and social inputs (specially the new power relations fostered by competitive policies), expansion of market economy, and technological changes (mainly changes in agricultural implements and crop patterns). Obviously, earlier monographic and ethnological accounts, by themselves, can hardly guide us in any futuristic analysis of rural life style, except as indicators marking out a baseline.

Yet, we proceed to suggest in the following pages, on an intuitive basis, some of the possible dimensions along which such studies could be mounted. These dimensions are illustrative rather than exhaustive, and are selected mainly on grounds of availability of personnel.[1]

Changes in the Village System:

One of the continua, on which India's rural future could be plotted, is the changing nature of the village community.

There are today visible changes in the traditional village culture. Along the rural-urban dimension, the village is fast becoming a different type of economic organisation, with a compatible and new social ethos. Soon, one suspects, there will be much lesser discontinuities between rural and urban lives in other areas too. For instance, due to the differential migration patterns in the villages, increasly the higher and middle caste families - not directly related to agriculture and yet, till recently the pillars of the village establishment - are moving out of villages. As a result, the village today, increasingly, consists of a population dependent more and more directly upon agriculture. Simultaneously, the centre of political power is now gradually shifting towards the low-status, but numerically prepondcrent, agricultural castes.

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[1] The following section deals with the traditional autonomy of the so called village republics, and the section on family with another alleged invariant of the Indian system, the family. The other pillar of the village system, caste, has been considered under the first heading.

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In sum, the autonomy of the village system, which was a function of the preponderence of sociocultural aspects of life over the economic aspect is being supplanted by the centrality of the economic organisations of an agricultural industry. This is breaking the dishotomous existence of rural and urban life styles and creating more continuous and complimentary urban-rural relationships. This calls for a systematic study of the penetration by the urban-industrial economic organisations into the rural society, with resulting spread of literacy; expansion of mass-media; occupational differentiation within families; changes in social composition through emmigration of priestly, business, and artisan castes; and the growth of small towns as new market and service places. In brief, the expected changes is from the totalistic social system of the traditional village to the economic organisation of quasi-modern economic farms.

This development has close links with the changes in village politics. Admittedly, this is a relatively better charted terrain and need not be specifically explore again. However, an analytic exercise could be undertaken, emphasising the growing prominance of lower and middle caste political styles (brought about by the increasing political power of those groups), growth of a sense of corporate community (in the place of the segmented caste identities within politics), the gradual internationalisalition of a dominant national culture of politics (including the acceptance of a competitive, open political order), and the coextending decline in oligarchic forms of power relationships within the village. An extension of these developments may be the increasing competition for power, not so much between the priestly and business castes (who have already lost power) and the deprived sectors (who have only now begun to seek power systematically) but between the latter and the emergent dominant castes, who traditionally enjoyed a lower status and have only recently acquired hegemoniatic economic and political power in many villages.

Changes in Technology:

The important thing here is not to study technological changes or innovations as such, which in any case could be more appropriately done under other rubrics of the over-all programme, but to concentrate on the cultural impacts of these changes and innovations in the rural areas. Some of the important considerations on his score are as follows: First, the sychology of close man-nature relationship is gradually being replaced by other forms of attitudes towards the environment. The older relationship was traditionally maintained through a low level of technology, intimacy between man and material objects, full acceptance of the predominance of nature or environment, and the traditional, hierarchically organised, occupational structure. As a result, social status, obstractive capacities and leisure were the privileges of a few men.

With the new distance between man and material objects introduced by technological innovations, it has become possible to partly dissociate personal status from status of jobs, give a new dignity to certain occupations (Particularly occupations that are economically profitable), create leisure for even the more deprived sectors of the rural population, and allow them the opportunity to indulge in abstract and symbolic-cultural activities. All this has further eroded the distinctions in life style based on caste, has created a more instrumental view of occupation, and has made the attitude towards the environment more manipulative.

There is another level at which the impact of technology can be studied. The technological inputs can be analysed with reference to their capacity to rectify the traditional life style, particularly by changing the patterns of control and ownership of the new technology. For instance, in the case of agriculture ownership - or, for that matter, "dealership" in things like improved seeds and mechanised farm implements (such as tractors, harvesters and threshers) - technological inputs have already dissociated status, power and work in some sectors of the rural population. It is possible to develop scenarios which will relate new patterns of status-power-work relations to technological innovations and diffusion.

Future of Family:

This brings us to the changes in interpersonal relationships as epitomised in the village net works and family dynamics. Here, we do not have in mind the conventional dimension of jointness versus nuclearity. Rather we are concerned with dimensions like decision-making within family, role concepts, intergenerational differences telescoped within the family, etc. All these are directly related to the changing complementaries within the interpersonal system which the family, the caste and the village constitute. For example, in the coming decades the family may become more central to the village life because of its increasing tendency to localise within it a wider variety of activities.

Also, and as a result of this, the family system is gradually becoming more autonomous from the village and caste systems. Whether this may take it subject to new stresses in the coming decades needs to be investigated. Lastly, the growing occupational differentiation in villages might enter the family system itself (for instance, because of faster inter-generational occupational mobility) and generate new crisis with which the traditional Indian family is ill-equipped to cope.

Personnel:

Some of the researchers who might be associated with these studies are:

Dhirendra Narayan : Psychocultural and in Basic Attitudinal changes.

P.N. Dhanagare : Rural Violence

Satish Saberwal : New Networks

B. Ramanujan : Changes in Within-Family Dynamics and Interpersonal Style.

Veena Das : Family and Kinship in Future

Anil Bhatt : Emerging Decision-making Styles and Power-Status Relations

K.C. Alexander : New Occupational Relationships

T.K. Domen : Changing Political Economy of the Village.

Ghanshyam Shah : Changes in Political Attitudes of Scheduled Castes and Tribes; Political Leadership in Lower Castes.

Andre Beteille : Changing Political Economy of the Village.

Pranab Bardhan : Rural Poverty

B.K. Roy Burman : Projections of Demographic and Occupational Profiles.

Some suggestions from Dr. J. K. Sridhar Rao, NCST Secretariat.

I. THEMES FOR INTEGRATED RURAL DEVELOPMENT

1. EMPLOYMENT-ORIENTED DEVELOPMENT PLANNING (GOALS):

Development encompasses social development, income growth and its distribution. Special emphasis should be given to the problem of employment in relation to overall development policy & planning. Development of a framework for policy making which makes explicit the links between employment, technology and output is essential. Value Systems and Life Styles at present and in the future (both Potential/Preferred or Probable). "Inventing" Futures.

2. TECHNOLOGY ADAPTATION (MEANS):

Adaptation, innovation and diffusion of technologies appropriate to particular stages of socio-economic development is essential. Also, efficient production technology should reflect on optimum use of labour absorbing techniques and make use of low-cost, locally available materials so that the policy may achieve the twin aims of generating increased employment opportunities as well as increased productivity.

3. SMALL-SCALE ENTREPRENEURSHIP DEVELOPMENT & COOPERATIVE INSTITUTIONS FOR EXTENSION & APPLICATION (AGENTS OF CHANGE):

Local entrepreneurship is an important link in the process of technology adaptation and employment creation, especially in the small-scale, labour-intensive industries. This theme concerns the identification of the functions and motivations of entrepreneurs in adopting and diffusing appropriate technologies. Institutional and Policy Framework which would create conditions to enhance such entrepreneurship is also of interest. Social Organisation/Cooperatives.

4. PUBLIC POLICY & INSTITUTION DEVELOPMENT (FRAMEWORK):

Some national and sub-regional developmental institution play key developmental role in the process of generation and diffusion of socially-relevant policies and technologies. The primary focus would be on discerning those factors which enhance their institutional capacity for developmental activities beneficial to local social and economic needs.

5. IMPLEMENTATION MECHANISMS AND FOLLOW-UP (FEEDBACK)

This includes monitoring, evaluation of performance/progress, user feedback systematically for better planning and implementation. Cybernatic systems for faster feedback using improved communications, T.V., Radio, etc. Present and Future Possibilities.

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II. AREAS FOR INTEGRATED RURAL DEVELOPMENT

- AGRICULTURE INCLUDING INFRASTRUCTURE

  Seeds Organisation, Pesticides, Soil conservation, Ecology, Animal husbandry, Dairying, Silos and other farm structures.
- VILLAGE INDUSTRIES.
- HEALTH EDUCATION and EXTENSION.
- WATER SUPPLY, DRAINAGE & SANITATION.
- TRANSPORTATION between village and market towns. COMMUNICATIONS.
- Reduction of Disparities and economically weaker and vulnerable section of society, through Employment Generation. (Goals).

III. STRATEGY (Manipulative Variables)

1. Agriculture & Animal Husbandry including Dairying.
2. Industry (Small and Cottage). Trade.
3. Economics, Transport, and Communication.
4. Fuel & Power. (Energy - Biogas, Rural Electrification, etc.)
5. Health, Education, Public Welfare. Services (Linked with items 7).
6. Banking and Cooperatives. Mobilising savings. Social Organisation.
7. Physical Environment - Human Settlements.
8. Urbanisation vis-a-vis Economics, Balanced Regional Development.

No. 4/39/75-NCST
March, 1975.

P.T.O. for Tables
relating to

(1) Typical Rural Settlements (Ekistics) Units.

(2) Stages of evolution of rural growth/development.

Reference: The Ekistics of Rural Development
Earl M. Kulp
EKISTICS, 224, July 1974.

Table 1
Typical rural ekistic units

Ekistic scale		Standard nomenclature	Rural Typology		Some typical rural administrative hierarchical structures (positioned on the table to show approximate scalar magnitude)						
Class	Pop.		Families	Population.	Uganda	Senegal	Peru	Thailand	Cambodia	Bangladesh	Taiwan
I	40	Dwelling group	10	60		Village 50			Phum 30		
II	250	Village	199	600			Pueblo Barriada[2]	Mubaan 600		Village 700	Village 700
III	1.5t[1]	Township	1,000	6,000	Parish 2,000		Distrito 5,600	Tambon 6,000	Khum 5,000		
IV	7t				Subcounty 12,000	Arronodissement 30,000				Union 9,000	Township
V.	50t	District	10,000	60,000	County 60,000		Provincia 60,000	Amphur 60,000	Srok 60,000	Thana 90,000	
VI	300t	Province	50,000	300,000	District 350,000	Region 350,000	Departamiento 420,000	Changwad 350,000	Khet 300,000	Subdivision 600,000	County 400,000

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1. Thousands

Unofficial units widely varying in size.

Table 2
Stages of rural ekistic evolution

Reference: The Ekistics of Rural Development
Earl M. Kulp
EKISTICS, 224, July 1974.

Feature	Stage 1	Stage 2	Stage 3	Stage 4
Roads	All-weather road to province center only	Paved to every province; all-weather to every district	All-weather to every township	Paved to every township; all-weather to every village
Permanent markets	Province centers only	Every district	Some townships	All townships
Crop-buying cooperatives with warehouses and trained managers.	Province centers only.	In many districts.	In many townships.	In all townships.
Commercial bank branches	A few provinces	Most or all provinces.	Most districts	Many townships.
Specialized shops	Province centers	District centers.	Some townships	All townships
Professional agricultural agents.	Province level only.	District level.	Township level	One per 3-4 villages.
Secondary schools				
Higher level (to year 12)	Most provinces.	Many districts	All districts	Most townships
Lower level (to year 10)	A few districts.	Most districts	Most townships	All townships
Medical facilities				
Hospitals (and physician)	Most provinces	All provinces	Most districts	Most townships
Clinics	Many districts	All districts	Most townships	
Orientation of farmers	Subsistence-mixed	Mixed	Mixed diversified	Diversified/ high value
Catalytic innovations	Improved seed	Agricultural chemicals	Small equipment horticulture	Horticulture Livestock
Illustrative countries	Laos	Thailand	Malaysia	Taiwan

Village India in 2000 A.D. - Dream and Reality

V.K. Gaur

'Time present and time past/
Are both perhaps contained in time future' -
T.S. Eliot

Around the year 2000 A.D. over 750 million people will be living in about 480,000 villages of India, most of them in the prime of their lives.

My dream is that, first and foremost, they will be full of enthusiasm and optimism for the future generated by a distinct scope of continual progress and improvement in the quality of their lives. This optimism in my vision, would spring from a nearly stabilized equation between his number and resources brought about by a conscious, deliberate and vigilant use of scientific methods of planning, resource generation, both human and material, and their utilization.

My dream is that human resources in rural areas would have been assiduously developed over the next 25 years through a careful identification of the most promising activity areas. That, as a consequence, most of them would have gained suitable employment to lend them a modicum of human dignity and thereby enable them to secure for themselves and their dependents at least the basic minimum needs: food, nutrition, and drinking water, shelter, clothing, sanitation, education and medicine.

My dream is that most of these people will have available to their villages, technological solutions and systems in the fields of agricultural inputs, groundwater, animal husbandry, soil and food grain preservation and harnessing of recyclable materials and solar energy for their needs.

My dream is that a village dweller would have become even more conscious and respectful of his intrinsic symbiosis with nature which alone guarantees him an unimpaired quality of life. That the pastoral scene, its environment, architecture and productive potential would have been made so attractive and the equation between the flow of resources and materials between the rural and urban centres so complementary and balanced that another most valuable bye product in a crisis area i.e. arrest of urban sprawl might eventually result.

Present trends:

A great deal has been done to transform the village scene in the last 20 years. Food production has been doubled. A large number of schools and hospitals have been added and communications improved. The list can be multiplied which will sum up to an impressive performance by any reckoning. But during this period the population in our villages has also increased from 285 million to 480 million. Today 30% of these are landless, a prey to the caprice of private employers. Over 40% live below the basic minimum level, and thousands of villages are without facilities of drinking water. Meanwhile, the population and the peoples aspirations have grown inexorably straining the already insufficient basic utility services, such as schools and hospitals, and creating an ever increasing backlog of left over people. The base paper on futurology shows a yawning gap between the basic materials that would be available in 2000 A.D. and those required. These projections use some very optimistic figures for extrapolating both these trends. But human ingenuity can yet step in to realize our dream world.

Human Culture-earth resource system:

The earth is a delicately provisioned planet with finite resources and known energy budget. Various regions of the earth have, in turn, their limited share of resources which cannot support an unlimited population without the environment and the quality of life, both being degraded. The quality of life (Q) is dependent i) on Resources (R), both human and material, ii) the capacity of a people for technological innovation (TI) in developing these resources and iii) the managerial and functional efficiency (S) of the system. It is also dependent inversely on the number of human beings (H).

$$Q \quad x \quad \frac{R x TI x S}{H^n}$$

The above equation is not quite so simple as it looks. For, both TI and S increase with R and again the latter with the former. Similarly the exponent n in the denominator varies nonlinearly with H itself as well as the desired grade of Q. But the equation does represent a statement of challenge and opportunity in realizing our dream which is signified by Q. Let us first look at the denominator.

Population planning:

It is clear that neither technological innovation nor system efficiency can be enhanced beyond limits for a finite resource budget, barring colonization of other planets, to cater for the needs of an unlimited population. Agriculturists are conscious of the carrying capacity of land which cannot be exceeded without counterproductive effects. True, that this concept in the human context is a dynamic one. Not long ago, nature used to prune our numbers to the carrying capacity of the land wielding its cruel weapons of famine, pestilence and war. Man, by his ingenuity has apparently struck these weapons from natures' hand but they still loom insidiously in our midst. Every now and then we save human lives from the jaws of floods and famine through great collective effort which is just sufficient to put them on the fringe of existence, to die slowly. The threat of war is averted by constantly denying nourishment to growing children and we still do not clearly understand the consequences of increasing human density and loss of territory on psychological stresses which might yet turn out to be the fiercest weapon in natures armoury.

We can do nothing to stem the tide that promises to increase the human population to 1000 million in 2000 A.D. But whatever we do today in this direction takes atleast 25 years to fructify. We are told that the growth rate will be lowered to 1.5% by the turn of the century i.e., the next doubling to 2000 million mark will take place in the year 2048 A.D. What is the carrying capacity of our land? Have we not reached it already in some respects? But the real question is whether it is larger than the population, we cannot help stall by the year 2000. My contention is that even if it be so, we should assume that to be the limit till such figures could be computed satisfactorily and deploy every instrument of political, economic, social and technological policy to ensure that the growth rate reduces to zero at the turn of the century. This to my kind is the minimum programme required to generate hope, confidence and enthusiasm amongst the new generation of men in the year 2000 who at that point of time, freed from the spectre of their growing numbers, could then look forward to a direct correspondence between development and an enhanced quality of life.

This exercise is within the compass of our capabilities. We shall need to impose some constraints on personal human freedom presently available, to ensure that it continues to be available to posterity hereafter. Constraints are essential for the wholesome organisation of complex systems and a classic example is the biosystem Man who for his existence needs far more critical conditions of physical, chemical and biological environment than does the simple amoeba.

Any constraints required of our people in the larger human interest cannot therefore be construed as a denial of freedom. Instead it will constitute a noble exercise of freedom to guarantee freedom beyond here and now.

Technology:

Even if a clear policy is enunciated now to plan for a finite population for the 21st Century by achieving zero growth by the year 2000 A.D. we shall need to deploy all our ingenuity to stave off the crisis of shortages during this century. I am often distressed by the fact that human requirements are only measured in terms of food frequently resulting in unfeeling optimism that ignores the deprivations of contemporary life. True, that food is the basic requirement followed by shelter. But once these have been met, the demands of human culture press onwards for education, transport, communications, medicare and so on. This should indeed be so and they acquire an equally significant meaning in my dream world.

It is also within our means to devise necessary technological blends and design systems that would enhance the resources of village India, particularly human resources and improve the utilization of land, material and energy resources so as to result in tangible socio-economic benefits. The major requirements are in the fields of adaptive and soft technologies and motivation of village dwellers to cooperate in achieving the desired goals.

Science and Technology are not strangers to village India but resource generation and their optimal utilization require a systems approach emphasizing the socio-technological nature of the total system. Necessary R and D areas both in social sciences and physical sciences can be carefully identified through systems analysis and simulation if technical and social institutions are entrusted with the task of designing suitable systems and technological packets for rural areas in their regions considering the assets and liabilities of the region as well as its interdependence with the larger environment. A proposal to carry out an interdisciplinary exercise for this purpose giving details was submitted by me to the D.S.T. last year.

A word about motivation:

Social systems are inherently insensitive to policy decisions made with a view to altering the system. There is also a fundamental conflict between short term and long term goals. But these systems do have a few sensitive influence nodes through which the system maybe preferentially guided. This is where we shall need R and D in social sciences as well as in selecting multidimensional criteria for defining socio-economic goals. Design of effective communication software for interacting with village dwellers as well as for influencing their behaviour will have to be carried out with great care keeping in view their cultural backgrounds, and use of audio-visual media particularly the latter, which incidentally also calls for a policy decision regarding the deployment of television and radio in creating a favourable public response.

TECHNOLOGY PRIORITIES FOR DEVELOPMENT OF RURAL AREAS

by

P. D. MALGAVKAR

1. The countries with limited resources are faced with almost instmrmountable problems in getting out of their predicament so that they can develop their resources as also improve the lot of their citizen. There is another problem in these countries, viz., the lot of the pocrest 30 per cent who do not have even the wherewithall to meet their barest physical needs.

2. The poorest people of countries with limited resources are both in Urban and Rural areas. Their presence in the urban areas is generally concentrated among those who have migrated from rural areas to urban areas in search of opportunities to make a living. Many are forced out of rural areas when draughts, famines or floods visit these areas, as they do not have the neans to sustain themselves for any length of time and their lwellings are such that they can recreate them from cast off wastes wherever they settle. (Their clustering in urban areas leads to what are called "slums" in the Metropolitan towns.) The main attention, therefore, has to be focussed on rural areas and people with a view to improve their conditions.

3. With the growing awareness of improving the lot of all the people and not only the average per capita income of a country, it has become necessary to consider the areas which affect the lowest 30 per cent of the people and see how far research and levelopment can be utilised for improving their lot. Such a strategy not only takes cognisance of the right of every human being born to have at least his minimum needs satisfied, but it also broadens the base of development thus enabling better economic levelopment.

4. Whilst drawing a plan for the development of the rural areas we have to make a distinction between what the villagers themselves want and consider as their urgent needs as against the elites' conception of what the villagers should have. Though very little work has been done on trying to understand the needs of the villagers, one may not go far wrong if one considers the following as their needs.

4.1 Drinking water :- Many villagers, especially in the summer time, have to walk for miles to get even the bare needs of drinking water. Water could, therefore, be considered as one of the first necessities of the villagers. (T.S. Swamy, Adviser, Central Public Health and Environment Engineering Organisation stated that in India only 39,000 villages had adequate and safe water supply, 13,000 villages had water supply infected with cholera germs and other health hazards like iron, chlorides and fluorides and 39,000 villages had both inadequate and unsafe water supply).

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4.2 Water for Crops: Today hardly 16% of cultivable area in India is irrigated. Because of this, food production is a gamble dependent upon the rains. Agriculturist sees his crop wither away for want of rains. Availability of water for irrigation will be a boon to him.

4.3 Medical attention : When a villager falls ill, he has to be carried to a hospital in one of the neighbouring urban towns. The lack of transport facilities many a time when people have to be carried in bullock cart to the hospital means that the medical attention is delayed and is resorted to as the last resort. Even para-medical doctors with some smattering medical knowledge would be a boon to the villagers.

4.4 Veternary assistance : Bullocks, cows, buffaloes, pigs, goats, sheep, etc. are the prized property in a village area. The importance of a person is known by the animals he has in his courtyard. He stays with his animals or rather the animals are tied next to him so that he can always have an eye on the animals. (This tendency of the villagers to consider animals as their valued property has even been carried by them to urban areas and persons, who can afford, keep their own buffaloes and cows in towns.) But these animals do not get veternary assistance in time. The untimely loss of a bullock or a buffalow is a great blow to a villager. If it could be prevented by proper veternary assistance, he would feel a great relief.

4.5 Manure : Manure for his crops is very important to him, because the crop yields have a direct corelation to the manure dosage. Despite the importance and significance of manures for village economy, however, he wastes the cow-dung that could give him manure, because of more pressing need, viz., fuel for cooking food. The necessity of finding energy for cooking, heating etc. compels him to use scarce resources like cowdung and forest wood for heating, whilst cowdung, grass, weeds, etc. can very easily be converted into manure. A study on energy consumption in India estimates that non-commercial energy sources, such as firewood, dung and vegetables wastes met almost 50 per cent of the energy needs in India in the year 1971.

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4.6 Black-smith : Formerly every village had a blacksmith with his blower. With the enchantment of urban centres, the blacksmith has disappeared from the villages. But the repair and maintenance of agricultural implements, bullock-carts etc. require the presence of a blacksmith, whether full or part time in every village.

4.7 Credit Facilities : The villager also requires credit facilities, both for his personal needs as also for his farming activities. But the Bankers take an impersonal view of the schemes to be financed in rural areas. They consider the project without the person behind it whose involvement and commitment to a project can be assured only if his basic family needs are met. But the project (farming, business, industry) does not take into cognisance the man and his needs. As the villagers do not have any other source of livelihood, they utilise the project funds for their personal needs, which is considered by the banks as mis-utilisation of project funds. So long as the financing institutions do not provide funds for the man behind the project, the financing of rural projects will lead to mis-utilisation of funds.

5. From the elite's point of view, when he visits the village, he finds the streets and roads littered with garbage, cowdung and night-soil. Children use the roadside as latrines, whilst the grown-ups go a slight distance away from the village for easing themselves. The insanitary conditions, the nauseating smell, the dirty streets and the soiled clothes of the villagers are an anathema to the elites.

5.1 Nutrition : Because of abismal poverty and ignorance, malnutrition is widely prevelant in rural areas. Though idealists draw the picture of a village as full of milk and honey, there is hardly any milk, not to talk of honey, whilst the vegetables are an infrequent treat in villages as there is no market for them. The eating habits are, therefore, confined to a staple cereal made palatable with a dose of chilly powder and onion.

5.2 Protected water supply : The elites want the villages not only to have water but that it should be protected against germs and diseases, so that the villagers may not suffer from water-borne diseases.

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.3 Improvement in skills : The skills of villagers, hether as a farmer, agriculturist, hand-loom weaver, lacksmith, carpenter, etc. have got to be improved f the productivity is to be improved. It is only ith the improved productivity that he will be producing ore from his labour which ultimately will get him better eturns.

5.4 Road connections : The accessibility of a village to a market, to an extension centre, to a centre of knowledge, to an entertainment place, to hospitals, etc. is possible through well-laid network of roads.

5.5 Communications : Extension of ideas to villagers, encouraging them to develop attitudes conducive to productivity, sanitation, nutrition etc. require a good communication network.

5.6 Family Planning : Large family to a villager is an asset as every child is a potential worker, whether in the field or to collect cowdung and twigs and branches of trees for fuel or to do hom chores. Because of the large infant mortality, it is necessary for him to have a number of children so that he is assured of some ready help at all times. The advantages and economies of family planning together with a health plan to reduce the child mortality will have to percolate down to the villagers. Only then, family planning will be of some success in the country.

5.7 Housing : The villagers, when they go to urban areas and build their houses in close proximity to one another, get styled as slum-dwellers, whilst what they are trying to do is only to duplicate their living conditions from the village in an urban area. Of course, because of the limited space in urban areas, the insanitary conditions get accentuated. Comparison with the concrete high-rise buildings and apartments on one hand and the thatched roof huts on the other become glaring.

5.8 Another consideration is that in the process of development of urban areas, the rural areas should not be the dumping ground of the refuge from urban waste.

5.9 Energy : About half the energy consumed in the country today comes from non-commercial energy sources such as fire-wood, cowdung and vegetable waste (out of 376 million tonnes of coal replacement energy equivalent consumed in 1971 in India,179 million tonnes were accounted for by non-commercial sources). This is a criminal waste of cowdung which can be turned into manure; of wood which is necessary for soil conservation

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and yet indiscriminate cutting of trees has been spreading in the villages because of the lack of alternative fuels. It may also be because the non-commerical fuel is gathered free, the cost being only the work of a child or the female of the house. Where home labour and time has no value, this could be considered as a free fuel. As soon as the under-employment and the unemployment becomes a thing of the past, the villagers will naturally find it difficult to collect these free energy sources.

6. The rural-urban dishotomy has to be removed at the earliest so that exodus from rural area to the urban comes to a stop. We will have to ensure that the skill and intelligence exodus from the villages to the urban areas is contained at the earliest. This does not mean that 80 per cent of the people will continue to live in the villages. With he growth of industrialisation, urbanisation will gain momentum and we envisage the rural population in the year 2000 A.D. in India to be between 60 and 70 per cent depending upon the growth of the economy. Thus the rural population proportion will continue to diminish, though in absolute numbers they will grow because of the high growth of population. The rural development policy would mean continuum of rural urban development complementary to one another, of urban growth centres spread throughout the country well within easy reach of the villages so that the people can have the advantages of urban areas and yet continue to live in rural areas.

7. Having studied the needs of the villagers as they see them and as the elites and the intellectuals see them, it is the task of extension agents, technologists, educationalists, regional development planners, etc. to work towardsa systems approach by which the needs of the villagers will be co-related with the concepts of the elites so that in making the village resemble the concepts of elites, the villagers find their needs fulfilled and their conditions improved.

8. The technologist is now in a position to determine the areas he has to concentrate on for improving the lot of the lowest 30 per cent of the rural people. These may be listed as -

8.1 Development of low cost community latrines which would be connected to bio-gas plants whose other feedstock will consist of cow-dung, weeds and village wastes. The biogas plants will convert all these into rich manure for the farm, eet the energy needs of cooking and lighting, improve the sanitation of the village and make it look clean. The present cowdung waste in India alone, it is estimated, will give energy equivalent of 100 million tonnes of coal and 2.5 million tonnes of nitrogen.

8.1.1 The harnessing of solar and wind energy will decentralise energy production units (as against thermal and hydro-electric plants which become more and more economical with larger and larger size thus tending to greater centralisation), reduce dependence on transmission lines and make possible the energisation of the remotest village or farm.

8.2 Health Service to rural areas demands on the one hand that it should be simple so that para-medical persons can administer medicines nad on the other the frequency of administration of doses has to be reduced so that the doctors need not meet the patients frequently and the villagers need not remember complicated administration of medicine dosage and yet get full benefit from it. A vaccine which can prevent pregnancy for 2/3 years simplifies the birth control programme as also reduces the frequency of visits by a doctor. If the same results can be achieved by an oral pill, the medical attention will be still more simplified.

8.2.1 The new trend in pharmaceuticals is in this direction. Already there are a large number of medicines available on the shelf of a pharmacy for combating a host of diseases. The development of ocusert containing anti-galucoma drug lasting a week which eliminates the need for eye drops four times daily is in the same direction. The technologists will have to move rapidly in this direction which will ensure better medical and veternary assistance, improve impact of family planning and birth control, and reduce malnutrition.

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8.3 Malnutrition can be overcome by making it possible for a poor man to have a balanced diet as his normal intake. One way of doing this is to increase his intake of meat, eggs, vegetables, dairy products, etc. The other is to enrich his nromal iet so that he gets his full requirements of proteins, vitamins etc. from his normal diet. Efforts in this direction will have to be increased by Agro Scientists so that the cereals and food with higher proteins and vitamins contents is grown.

8.4 Water shortage scarcity and impurity are endemic problems of villagers. Locating ground water, tapping both ground water and running water cheaply, better conservation of water, and methods of purifying water have to be developed by respective technologists if we are to meet the basic problem of water shortage and impurity.

8.5 Roads and housing at present cost a great deal. The cost of a bare house is some 20 times the per capita income the people. For the lowest 30 per cent it may be 50 times. The dwelling houses need not last that long. Dr. Baker in Kerala has developed cheap houses from locally available material which can be built with locally available skill at much cheaper cost. The problem of housing is so huge that the technologists will do well to put their efforts in developing cheap houses with local material and skill. The problem of roads is akin to that of housing.

8.5.1 Some rudiments of town planning or village planning will have to come to villages if the villager has to overcome the ribbon development, close-clustering of huts, winding roadlets and foot-paths, living together of animals and men in one environment and the dumping of refuge and excreta in the vicinity of houses. Some thought will also have to be given to the designing of houses so that one could construct cheap houses with locally available material, which should not be fire-hazards and which would allow air and light to come within the huts.

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8.6. Communication is a process both of improving the receptivity of the villagers by literacy, attitudes and values and making information available to them. The problem of countries with limited resources is that they do not have even the means to remove illiteracy quickly. The scientists, therefore, will have to develop communication means which directly appeal to the ears and eyes of the villagers so that the hurdle of illiteracy is overcome. In this process, however, we must keep in mind that the analytical and critical faculties of the villagers are not overwhelmed by the outpourings from the media, as the greatest strength of an individual is his ability to think, analyse and chose.

8.7 We lament the lack of skill in the villagers and yet have apprenticeship training programmes lasting for three years and over. Just as we are thinking of para-medical doctors, we will have to devise techniques by which we can quickly impart the rudimentary skills to the villagers in a very short time. The techniques for this are known and were prattised during the last war to train a host of skills in a short period. We will have to go further and see how we can expedite and simplify the process of skill transfer to the villagers.

9. We are now in a position to place herebelow the needs of the villagers as they see them, as the elites conceive them, and the role of the technologists.

The needs of the villagers and the technology inputs required -

as the villagers see	Technology	as the elites conceive
Manure	Biogas plant	Energy for cooking & light
	Solar & Wind Energy	Insanitary conditions
Medical attention	Medical service -simplify	Family planning
Veterinary attention	-reduce frequency	
	Fortify food with proteins, vitamins etc..	malnutrition

contd...

as the villagers see	Technology	as the elites conceive
Drinking water & water for irrigation	Ground water location	-
	tapping water cheaply conservation of water purification of water.	Protected water supply
	Housing and Road Research	Better Housing Better Communication
	Audio-visual Communication.	Better receptivity to change
	Training technology	Improved skills

10. The credibility of the technologists will be established when the technology they develop meets the needs of the villagers as they see them. Priority, therefore, has to be given to the first four areas of technology as these meet the needs as seen by the villagers and as conceived by the elites. From thereon the technologists may take up other areas which help improve the lot of the villagers.

11. A look at the needs as villagers see them, indicates that only one need, viz., credit is not amenable to technology This area will have to be tackled with an innovative credit planning approach. Already, in a few pockets innovative Bank Managers have shown that this can be done. The extension agencies will have to spread the effects of such approaches to all the rural areas.

12. Technological development in the areas listed will help the already affluent persons to the extent it augments manure and irrigation water and improves veterinary services as only cultivators of land and owners of animals will get benefit from them. But in all other areas the whole range of population and more particularly the lowest 30 per cent will get the maximum benefit as they suffer from the deprivation of the facilities the most as they do not have the means to meet these needs some other way. Medical attention, protected drinking water, energy for cooking and light, improved village sanitation, overcoming malnutrition, better housing and communication, improved skills, and better receptivity to change all go to ameliorate their health, attitude, earning power, and living conditions. Technology will thus have broadened the base for development and at the same time improved the lot of the lowest 30 per cent considerably.

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3. Of course, there are many more problems faced by the rural areas which the technologists will have to tackle- such as draught and flood control, utilisation of resources and wastes, development of marketing network so that goods can be sold and bought at reasonable prices, etc. The role of technology is never-ending. He has, however, to begin at some stage. The paper makes a case for his beginning in areas which will meet the needs as conceived by the villagers themselves.

URBANOLOGY

URABAN STRUCTURING

INTRODUCTION

The term "Urban Structuring" refers to the organising of various apparent and non-apparent 'urban structures' as an integrated system of organising ACTIVITY in relation to ENVIRONMENT in a city.

'Urbar Structure' means the broad frame-work of individual 'urban forces,' exerting in a planned, semi-planned or even unplanned manner on an existing or proposed urban environment characterising the quality and intensity of HUMAN EXPERIENCE in a city.

This concern of human experience in a city is an extension of the architectural concept of 'designing a building' but differs in scale, magnitude and complexity of numerous controllable and uncontrollable factors exerting on city fabric. These include social, economic, functional factors which keep on chaning-continuously shaping the physical form of a city.

A city represents various connotations, experiences, associations, conjestion, confusion, smells, sounds, colours, places, buildings, roads and environment affecting each person according to his particular predilections. From his environment each person constructs his own mental picture, likes and dislikes of parts of the city in physical relationship to one another. The most essential parts of an individual's mental image overlap and complement those of other persons - this constitutes the "impression of a city" which may be good or bad, static or dynamic, economic or costly, efficient or unorganised.

The basic concern of the people in a city is the economy and efficiency of its "functional organisation" on which the "city life" is structured.

NEED OF NEW APPROACH

A city consists of various functions - residences, work centres, shopping centres, industrial complexes, educational and institutional areas, cultural centres, recreation centres and natural open spaces. To be able to utilise these variety of functions one has to overcome greater or shorter distance which in effect causes "FRICTION". To overcome this friction of space i.e. the distance, we can either transport people to the necessary functions (centralisation) or we can move these functions to the people (Decentralisation). The latter concept involves danger of duplication with resultant increase in cost and possible under utilisation of public resources.

In the Indian context where urbanity is increasing at an alarming rate - "Urban population in India is expected to increase from 79 million people in 1961 to 152 million people in 1981 or roughly double in size over this 20 year period. The number of towns in India with a population of 50,000 or over is expected to increase from 250 in 1961 to 536 in 1981.

There are today 12 cities exceeding 500,000 population and 113 cities exceeding 100,000 population mark "(Background paper or NCST regional seminar) - it is essential to review the existin planning techniques.

Town-planning today is based on two diamensional area-use planning, sectoral density distribution and road networks which do not ensure a viable 'living environment' or efficient and economic movement pattern. 'Master Plans' are based on accommodating a (projected population figure' on surrounding land as per low-density neighbourhood planning standards borrowed from developed societies where the socio-economic, technological and transportation factors are very different.

In an over-populated country like ours, conservation of la as a resource, diverse socio-economic groupings and environmental criterias are practically ignored by town planning disciplin in favour of "bye-law planning" and suburban sprawl. Delhi has grown over 30 miles in either direction without any relevant transportation mechanism resulting in lack of efficiency of public utilities, services and mobility and increased cost of development. Similarly, transportation planning is based on irrelevant techniques of vehicular (CAR) capacity and trends related to existing trip characteristics without any base of mass transit, obsolescence of particular mode of transportation (e.g. hand thelas, tongas, cycle-rickshaws etc. which should be discouraged on public health grounds). It does not consider the induced and supressed trips, travel cost and alternate modes of transportation. The present technique may be valid for homogenou car oriented traffic but it does not relate to highly hetrogenou traffic of Indian cities.

Large amounts of money are being spent by every State and every city in "improving the roads" by widening the carriageways, altering the intersections and increasing the number of buses indiscriminately. Delhi alone has spent over 2 crores in road improvement during the Asian Fair - but to what use - the number of accidents around India Gate hexagon have increased, buses have started loading and unloading on the "slip islands", it has become more difficult to cross the roads because of increased traffic and wider carriageways, and social crimes have increased because of sealed accessibility to the large open area. In Bombay, a foreign team had proposed several road improvements (two of which have already been incorporated) without considering a viable mass-transit system with the resul a major project had to be shelved recently.

In India the problem is that of moving masses of people rather than number of cars. It is highly doubtful for future also to think of our society as a car oriented society based on self contained low density communities with centrally located public facilities.

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URBAN ORGANISM

A city is a 'static thing' in the sense of its physical being i.e. houses, streets, buildings etc. But a city also represents a "dynamic organism" in the form of human, social and economic activities like living, working, education, recreation, purchasing and manufacturing.

It is this dynamism of ACTIVITY that fills in the static spaces (i.e. buildings, streets etc.) and giventhe whole a "City Life". A singular type of use is not sufficient in itself to give the life - for the activities are inter-dependent. They compli ment and generate each other. The term 'activity' connotes utilisation of more than one use as a sequence of movement. Activity generates from inter-action of comptatible landuses and is recognised as the organic force imparting life to a city.

Intermixture of uses has been a timeless universal phenomenon. In the countryside man lives with his cattle, grain and fodder sometimes housed under the same roof or enclosed within a compount. His major place of work i.e. the farm may be situated at a distance which he can reach easily but his living environment is more complex than just a living place. In a city the urban dweller lives over a shop, besides a cinema house or over a parking garage on the street. All these elements procured him the desired way of living adjusted to his requirements.

The inter-dependency and interaction of compatible landuses should be recognised by the planners as the organic force imparting 'life' to a city environment.

The new approach to planning is based on scientific analytical techniques by various disciplines in an integrated manner to organise the "Basic Urban Structure" as an economic, coherent and efficient system on which activities can generate to provide the "city life" and developments can take place to shape the physical environment as a system of "Living Pattern".

STRUCTURING OF ACTIVITY

Urban developments should be structured on 3-dimensionally integrated activity systems. the term "activity" will mean a broad framework of complementary uses conceived in relation to movement pattern that may develop because of interaction between various singular uses. A tailor's shop dry-cleaners shop, a bakery or a confectioners shop, a small printing press, or a gas station may be as much needed in a retail shopping centre as fashion shops and boutiques. Similarly office space, residential flats, or a library can be located above the shopping centre to provide needed 'City Life'.

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various movement systems like mass transit, railways, air and water routes, local transport system etc. should be organise as the "overall transportation structure" for a city development supplementing and even overlapping each other to provide optimum number of alternates to the user.

Following may be taken as operational steps for organising 3-dimensionally integrated activity system:

1. IDENTIFICATION OF ACTIVITY NODES: Nodes may be defined of concentration or critical points of varying magnitude and importance; they indicate a place of identifiable activity. Activity nodes may be intersections, joints or terminals of movement system which acquire relative importance to their environment or important landmarks in a city.

   To become "Meaningful" in today's conte of urban development, we shall have to inven a new vocaboulary of terms, cannoting or analogising parts of the old city. Urban nodes may be conceived as:

   i) "City GATE" major transportation centre in a city such as railway stations, inter state bus terminus, mass transit terminal city terminals for air travel etc. Points of interchange from inter-city to intra city transportation system.

   ii) "CITY ROOM" is a transportation centre of a lower heirarchy like city bus terminals local railway stations, mass transit stations etc. Points of interchange between intra-city and local system of movement.

   iii) "CITY MODE" is like a door to a particula activity centre such as mass transit station, bus stops, parking gaurages, etc

   iv) "CITY LOUNGE" where people are able to relax for recreation, particular visual landmarks etc.

2. IDENTIFICATION OF LINKAGE: Linkage can be defined as the 'glue' of the city. It is the act by which we units all the lay ers of activity and resulting physical form in a city. Between any two activities centres, a linkage may develop depending on their magnitude and the distance between them. A linkage may acquire the character of a "spine" when a continuity occurs between two nodes.

3. LEGIBILITY: In so far as linkage and nodes are successful the city is a recognisable and humanly understandable entity of city life we depend on understanding how two events within a city are related - say house and the bus stop, shopping centre and the railway station etc. or any combination thereof - to make a comprehendible relationship.

4. SEQUENCE: of an activity depends upon the organisation of micro or macro spaces ina complementary manner to avoid 'friction' and to create a 'city life'.

5. INTENSITY is the quantitative gradation of activity based on organisation of movement system and its location in the city.

6. CHARACTER is the nature of an activity in its qualitative sense.

7. QUALITY of activity is the "desired resultant" of urban structuring including physical, social, economic and functional criterias.

Urban aesthetics is a corollary of inherent urban forces varying from person to person. However, what we need in our cities is an overall good background architecture instead of well worked out architectural monuments. This is city architecture which should be as simple and as basic as possible, allowing for a maximum flexibility within, but providing an overall relationship of an area. We must evolve as such a modular architecture related to human response, transportation network and techno-economic feasibility to provide aesthetic urban environment with natural as well as man made elements complementing each other.

'Quality of Urban Environment' will depend on the structuring of activity system in a sequential manner providing optimum efficiency, economy, social interaction, pleasant physical environment, comfort and legibility. It is the "controlling of the quality" by all concerned professionals that will make a development desirable or undesirable.

URBAN RESTRUCTURING

In most cases our cities are a result of gradual expansion and final explosion of our earlier towns. This change has occured because of various reasons like population explosion, immigration technical advancement, fast pace of industrialisation, instant communication systems and the choice of alternatives offered by the city life. The cities of the past have become a sector in the present city. They have almost lost their identity in the present city. They have almost lost their identity in the present day magalapolis.

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When the function of a city develope the static city gets adjusted to its techno-economic needs, which occur so quickly that the physical or the static form of the city has hardly any time to adapt itself to this change. The dynamic activities therefore, get distorted in the given static form resulting in chaos, conjestion, confusion and misery.

Professor Kenzo Tenge has said in his statement to "Japan Architect" (Architectural Magazine);

> "Short-lived items are becoming more and more short-lived, and the cycle of change is shirnking at a corresponding ra On the other hand, the accumulation of capital has made it possible to build large scale operations. Reformationnof natural topography, dams, harbors, and highways are of a size and scope that involve long cycles of time, and these are the man-made work that tend to divide the overall system of the age. The two-tendencies - towards shorter cycles and towards longer cycles are both necessar to modern life and to humanity itself."

Although, we have as yet not accumulated as much capital a some of the developed countries, we are realising the need of i Every effort is being made to pool the resources and provide th necessary long range changes since they are acquiring primary importance at the national level to boost production and improv economic prosperity.

It is commendable to note that Planning Commission has alr prepared mass transit studies for five cities and will undertak eight more studies in near future. This certainly is a significant beginning and offers a great opportunity of reorganising our cities. The town planning discipline should make a special note of this and should plan for ACTIVITY SYSTEMS instead of la use planning.

The mass transit corridors need to be located along the most efficient and economically viable routes because of heavy investments. The activities generated and the rate of growth of intensity in urban centres should be organised as a systen of en couraging and discouraging activities and uses providing suitable alternatives with adequate incentives to relocate less desirable use.

As a matter of fact, at times "Synthetic approach" to location of certain major activity areas should be used for developing certain parts of the transit corridor to help in rehabilitation of old cities and overgrown uses. For example, a particular use like a whole-sale market, vegetable market, large industrial area or any other macro intercity or regional function may have been surrounded by residential developments - such uses can be located even outside the operational periphery of mass transit system with perhaps a subsidiary feeder route.

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CONCLUSION

However, what is happening today is the lack of proper coordination between various transportation systems and lop-sided spot development of transportation centers by individual agencies – for example in Delhi, the Inter-State Bus Terminal is located on the North side of the old city whereas the city has expanded in the South and in the West. Again it has practically no direct relationship to the railway stations or to the gravity of population or to the intra-city movement system. The mass transit corridor which has been conceived as North-South and East-West connector does not relate to the polynuclear character of Delhi with proposed decentralisation of work centre along a ring outside the city. The proposed mass transit do does have some merits but will mean a "total reorganisation of landuse structure" based on activity system of the city in place of low density suburbs based on "individual mode of transportation". A compromise may result in radio-centric development of the urban corridors.

It is imperative to review and restructure our planning techniques and invent, if needed a new process of inter-disciplinary coordination for achieving viable urban environment tomorrow.

We have stepped into a new era of mass transportation and should adopt it as a rationale of urban planning. This new cycle is a long range time cycle and offers unique possibilities of restructuring our dilapidating cities by controlling developments in a desired manner. It is suggested, therefo re, that comprehensive studies should be undertaken of mass transit corridors and major movement ysystems in our cities on a priority basis to organise "CITY LIFE" as a congenial system of urban living.

This process in itself is an inter-disciplinary synthesis and needs coordination of various professionals including architects, urban designers, town planners, urban economists, sociologists, transportation planners, railway engineers and landscape architects besides administrators, policy makers and community leaders. The office of Environmental Planning & Coordination and the National Committee of Science and Technology does provide an opportunity to organise such a forum. It is in this context that I present this prelude for a though towards adopting ACTIVITY SYSTEM as the basis of URBAN PLANNING.

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Points for Discussion in first meeting of NCST

Group on Futurology

Technical Sub-Group
on
URBANOLOGY

Proposed by
Dr. J. K. Sridhar Rao.

1. Check list of major problems facing different urban areas (as a part of continuam of human settlements) vis-a-vis present and past practices and experiences... Brainstorming session on "What is wrong with the present way of dealing with the Urban Problems". Identification of positive growth factors and Strategy and Mechanisms of Survival in the future.

2. Issues, Priorities, Imperatives, Economics and Socio-cultural Realitics. Practices and contradictions in Urban Planning, Development and Management including maintenance of public services in urban areas vis-a-vis balanced regional development - Signposts to the future in a changing society in an age of discontinuity. Contradictions, conflicts and choices. Projecting into the future.

3. To initiate Study to define framework of development of appropriate "government technology" covering all aspects of planning, implementation, maintenance and problem-solving action programmes - at all levels in a suitable time frame from present to say 2000 A.D. Interdisciplinary programmes.

4. Sponsorship of in-depth studies, for example,

   (a) Devdlopment of elaborate Urban Dynamics model suitable for Indian conditions on basis of detailed study of some of the metropolitan areas. They would be needed to predict the future state of cities, region and nation (as an ultimate objective) and would help to predict the outcome of various proposed plans on these states.

   (The computer study by Dr. P.V. Achuthan of Department of Mechanical Engineering and Prof. C.K. Ramesh, Kepartment of Civil Engineering, IIT, Bombay relating to Bombay New Twin City Metropolitan areas should be expanded in defining realistic parameters, indicaters in the Forester Model used by them).

(b) Towards defining the shape of community realistic for diverse socio-cultural factors and appreciation of changes in Political Processes, Administrative, Financial and Management Patterns.

(c) Operations Research for Public Service Utilities Systems in Urban areas.

(d) Government and Management Patterns of Urban areas in the future.

(e) Models and Case studies/Feasibility Study for viewing Urban areas and Market Towns and growth centres of production and distribution and regional balances rather than the conventional 'welfare' approach to urban questions and the hopeless attempts to achieve arbitrary standards of city life emulating western patterns.

(f) New concepts in Urban Renewal.

(g) Towards Better cities of tomorrow - Role of Science and Technology in Urban Development.

(h) Towards defining the Ideal Indian City of the future in the context of rural settlements and regional development (simultaneously the morphology of an Indian village needs to be studied.)

CITIZEN FEED BACK IN AN URBAN SYSTEM

by

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"Any dynamic system, to be stable, needs feedback."

Applying this sybernetic statement to an urban-system means that the Authority concerned with the state of affairs in a city should be aware of the residents' perceptions of their environment, including their reactions to the results of the decisions made and action taken by the city authorities which produce an impact on the citizens' lives. This 'feedback' information should be used to modify future decisions suitably.

1. Need for a Feedback System :

1.1 The Urban Development authorities spent a lot of money on providing amenities to the citizens. Such an expenditure is meaningful only if the citizens perceive the benefits of the facility provided and know how to utilise them. As the UDA gets the feedback information that a particular facility set up by it is being put to 'use' it can conclude that the decision to set up the facility was correct and can think in terms of expanding it or providing complementary services. (There is otherwise the danger of a "Marie Antoinmettesyndrome" in the expenditure priorities.)

1.2 Once a facility has been adopted by the citizens, periodic feedback on its functioning gives confidence and assurance to those at the helm. Feedback indicating mal-functioning (or indicating a change in client needs) can lead to timely rectification measures and therefore to efficient use of public funds. It is also useful to know what uses the citizens think are proper for a facility. For example, a park built up with the objective that the old people and children will use it might seen to be used in fact for playing football. This leads to two alternatives for the UDA-either it can put up goal posts, etc. and make it a proper football ground or put up trees and benches to confine it to old people and children. (In either case, we can build another park for the other use.) The point of this example, of course, is that the UDA has had the alternatives effectively raised so that a reasonable choice can be made.

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1.3 This brings us to the question of 'felt nedds'. There are certain things to be provided and which are quite obvious to the UDA. But it is quite possible that there are things which the citizens feel a need for, and of which the UDA is not aware. In this situation the existence of a proper feedback system would provide a channel for the citizens to make their needs known to the UDA which can then take a decision within its plan and financial constraints.

2. Kind of feedback : Feedback from the citizens can be classified into two categories.

2.1 One is 'Service Feedback' relating to the availability and functioning of city services. These can be a request for information, the lodging of a complaint, or the seeking of a service. Its involvement with city authorities is of a short-term nature.

2.2 The other kind is 'Involvement Feedback' which can be expressed opinion, a suggestion, or an offer to volunteer. This kind of feedback unlike service feedback has long-term policy level implications. This distinction must be made so that the feedback channels which are built up are appropriate to the type of feedback. Both kinds are needed.

3. Urban Services and Nature of Feedback : There are three kinds of activities going on in an urban system.

3.1 First is the routine work of providing the necessities of city life which involves – power suply, water supply, sewerage/garbage disposal, drainage, transport/roads, public health, communications (telephones, newspapers etc.) and cultural activities (like parks, libraries, museums, exhibitions, festivals, etc.)

3.1.1 The routine operation of city services should generate service feedback. Citizens know that services are available and what action to expect and they demand them or complain about their malfunctioni functioning. The feed-back is generally addressed to a particular department and is expected to trigger action in a short time.

At present it is quite apparent that these systems are not working, in general, to the satisfaction of citizen citizens....but we often lack the precise information to decide what the priorities should be in making improvements. This lack of a priority, scheme results in, or elicits, the usual bureaucratic response about 'lack of funds'. There would be plenty of funds if we had to spend them only on one object at a time.

3.2. The second kind of activity which any UDA might take up is 'one-sheet' or newly initiated projects. This category of activities might include - building a rail over-bridge, putting up a new market centre, installing a new traffic signalling system, the decision to make certain areas exclusive to pedestrians, charting routes for new roads, deciding the location of a proposed college/school/hospital, etc.

3.2.1. In a democratic set up the process of 'feed forward' is very essential before undertaking the kinds of projects mentioned above. Feed forward means communicating to the citizens what is proposed to be done.

3.2.1.1. It has two effects. Firstly, it helps create a felt need in the citizens. It is quite possible that the feasibility and short and long-term usefulness of a proposed project might not have occured to the people but when they are informed that such and such thing is going to be done, they realise that it will be a good thing to have. This induced thinking can help ensure citizdn commitment, cooperation, and eventually protection of the facility.

3.2.1.2. The second effect of feedforward is what it provides the citizens with information regarding what is going to happen and gives them an opportunity to react; and therefore to participate in the decision.

3.2.2. This involvement feedback can result not only in a better match between the proposed amenity and civic needs, but also perhaps in physical contributions from citizens and voluntary agencies in property, equipment and time. Too often the government agencies assume they know all; they resent and resist voluntary agencies and set up a self-fulfilling prophecy that non-official groups are obstructive. Actually in such a complex community as a city, it is only through understanding the information transmission and morale-building functions of voluntary agencies that we can keep thd system in a stable condition.

3.2.2.1. We can also think of a situation where the casual relationship would be reversed. Instead of the sequence being project-feed forward-involvement feed-back-finalisation it can be involvement 'feedback-decision-project'.

The citizen(s) on his own initiative can send in a good suggestion, which after evaluation leads to the decision to undertake a project.

.3 The third kind of situation in an urban system can be Emergencies-riots, fire, earthquake...Situations which can lead to calamity if not tackled instaneously can also be classified under this category e.g. dangerous crack in a bridge wall or building, missing railings, dangerous potholes, manhole without a cover.

3.3.1. The feedback and action needed here is of a different kind. Everything has to be done in 'real time'. The changes in the situation have to be fed back to the decision making body, minute to minute, and it has to decide and act instantaneously. Generally, once the situation is known, the authorities can find out the details on the spot, but prompt information from citizens can help prevent the situation from getting too serious before authority i s alerted. Even after the authorities are on the spot he can be complement to the -in action as well as intransmitting information.

3.3.1.2. After the event, eye witness feedback from citizens can help determine causes and chalk out preventive measures for the future. These uses of citizen participation-organised or individual-are vital in countries like India where social, religious and languages misunderstanding are so frequent.

4. Organising to Receive Feedback : This means that the bureaucracy has to structure itself in a such a way as to facilitate action on feedback. If the citizens keep on sending feedback and no timely action is taken, they by and by it will come to be recognised as a fruitless activity-and a charm develppes between the people and their administration.

4.1 Past experience demonstrates that departmental feedback channels as in operation now are not very effective for understandable reasons. The reason is human nature - which the behavioural sciences now now take seriously. It is very difficult to view one's own activities objectively. There is always a tendency to defent one's actions. If you go and tell a particular department that they are not functioning properly they will at best recount the enormous odds they are working against; more often they become hostile to you.

4.1.1. The second hurdle is multifaceted for it lies in the processes built into the system we have to use. Bureaucracy by definition is ponderous and rigid in its methods; this does not have its advantgges too, but it invariably leads to delays in decision and action. The 'concerned sections' must first be identified, then files are taken down from th dustry shelves and then files are taken down the dustry shelves and passed up and down the the hierachical ladder with an ever growing number of notings and "may see"s, and finally a form letter "regretting" is sent to the complainant. This defeats the very purpose of feed-back, though in bureaucratic terms, "complaint" has been disposed of. It is only by understanding the purpose of citizen feed-back in the urban system, and having a realisti idea about bureaucracy and its patterns of work ing that we can plan how to effectively obtain active citizen involvement and positive citizen participation. The recent government circular on 'Complaint Books' in public offices is a good occasion to review the system of feedback.

4.2 The solutions to both these problems are the same - to demonstrate that "it works" - that a feedback system not only achieves a more satisfied citizenery but also gives more satisfaction in their work to the civic operations staff andbureaucrats. Unless both these partie are more pleased, there is little chance for a singal innovative notion to survive.

As a matter of fact, once we accept in principl the idea that citizen-feedback (leading to greater administrative awareness) is a good thing, we open ourselves to a fresh look at cit management and organisation design on cyberneti principles. Taken together, they can provide us with a scheme for a city management system which is more 'flexible' - yet more stable; quick to respond to emergencies and to short term needs, yet more effective in implementing long term plans.

Other than 'feedback' to all action cells what are some of these principles? It is not possible in a short note to spell out and to apply them, but we will suggest a few here to demonstrate that cybernetic ideas are by no means mechanistic and that they do accord with the accepted practice. It is true, however, that they go futther and take a broader view of things.

1 "Centralise these decisions and activities that require insulation from current happenings and a long view; decentralise disperse downward - those decisions and activities that require rapid response in time or a high degree of detailed case information."

To implement such a principle it is first necessary to classify activities and decisions within the city administration in terms of categories such as (a) Is their time-sczle for action short or long, (b) Are they basically internal processes (such as selection, training or accounting) or externally-oriented processes (such as bill collection, water supply or public health); (c) Do they work on current information flows or on accumulated information; (d) Ar they basically doing their work according to present rules or most they use discretion (if rules, what are they supposed to do about exceptional cases?); (e) How much training is required for this function (where does it fall in a skill hierachy?). Categorisation along these dimensions (and other relevant ones) which could be listed) will be the first step in deciding whether a decision or activity can be decentralised out to the periphery of the administrative structure (or whether it should be insulated carefully in the heart of the structure), and the manner in which it should receive its 'feedback' (whether directly from thd field or after processing and analysis by a higher echelon or a special cell).

.2.2 "In general, raise the proportion of the agency's resources that are being spent upon "information processing" as against program activities." For one instance, if debates in the municipal councils are recorded and indexed, we could avoid rediscovering the same facts ehen an issue comes up for consideration a second time. For another instance, if there was prior recording of economic activities and their locations, they can be analysed when bridge, highway, rail terminal or housing decisions have to be taken, but it is not possible to do more than use "common sense" unless the data has previously been carefully collected, screened and stored in a form suitable for ready analysis. Thd savings due to a single better location-decision is likely to pay for the entire information system.

4.2.3 "Provide a hierachy of feedback loops to monitor, motivate and keep under control the processes in a living city". Also, "design-in multiple information channels so that important information gets through even if some channels are 'blocked' for whatever reason." Consciously design and use system-wide codes" - that is, common terminologies and ways of treating pronlems - so as to facilitate communication between different groups in or outside the administration whose cooperation may be useful. Allociated with this last, and closely linked also to the idea of citizen-participation, is the new technique in organisational development called "Open systems planning", wherein the organization itself becomes more of an open-systems, a communicating system, than a compartmentalised formal hierachy.

5. Technology and Feedback systems :

It may be asked how an innovative idea like citizen feedback can be implemented effectively. The traditional methods such as complaint books or complaint desks or enquiry counters do have permanent virtues, but even they are far more complex systems than they appear to be at first glance. Not only their location and timing but also the training, career channels and reporting hierachy of the staff is part of the system to be planned. It is also possible to use other channels.

5.1 Here are a few

(a) "Open Evenings" with citizens

(b) Mohalla-wise public meetings

(c) Postage-free letters

(d) Special 'free' phone numbers to report
report water, sewage emergencies

(e) Walkie-Talkie (particularly for emergencies)

(f) Radio discussions recorded earlier at different places and followed up by group meetings around community sets

(g) Filming and/or video taping of the municipal and other top-body meetings so that people can see for themselves how decisions are made. (Videotapes can be played-back on community centre VTRs, and then used there to record citizen-feedback which can be edited and shown to the city fathers.

6. Conclusions :

After having enumerated the pros it will be illogical not to consider the possible 'cons' of a feedback system also.

6.1 An efficient feedback system which guarantees prompt action on citizen-feedback can also lead to the 'monkey reaction' people would ask for things just because of the novelty of being listened to. This could degenerate into naive and meaningless demands. They might also ask for things which they could very well do themselves or which cannot be done given various constraints and might throw tantrums if they do not get any action.

A short run solution to this is a matter of fact, cards-on-the-table approach where any unreasonable feedback is returned with an explanation. Proper civic education can provide the long run solution.

6.2 Initially the citizens have to be told that a feedback system exists and what its mechanism is. But more important is the education which can teach them to take initiative and demand action. They should also be made to see their role in urban development and what they can do on their own without looking up to the authorities, e.g. maintenance of facilities like parks. Simultaneously they should be made to understand the limitations on natural, financial and manpower resources.

6.3 The process of education in this context can be through effective news and feature stroies(even comic strips) in the mass communication media in the short run, and through bringing about civic awareness during school education, in the long run. This task would be made easier if the citizens have a sense of belonging to the city - have the concept of 'our city' and if the education authorities adopt schooling "for life", instead of for examinations as their motto.

* * *

URBANOLOGY

b y

BHARAT KUMAR BANSAL*

The population of India is expected to increase from 548 million persons in 1971 to 658 million in 1981, 801 million in 1991 and approximately 945 millior in the year 2001. This estimate is based on the assumption that family planning programmes will succeed continuously and the average expectation of life and birth will improve. The overall decadel growth rate is expected to come down to 38.2% in 1961-71 to 35.6% in 1991-2001.

2. The high rate of population growth assodated with comparative high fe tility rate implies that prpportion of young people below the working age (16) will also be high. The impact of an increased population growth of labout force is felt only 15 to 20 years which in this case is the period during which dependency burden will rise. This implies that a large number of new entrants into the labour force may have more serious consequences than the mere increase in dependency burden.

3. In India where almost 40% of the population lives below the poverty line, an 100% increase in population may outpace the availavle resources and may cause further reduction in the levels of livingunless significant technological changes are adopted to meet the challenges of the changing society and economy of the country.

4. According to projections made by the Registrar General of India, the current trends of urban and rural growth will result in 30:70 ratio of urban/rural population by the year 2001. It means that an additional 240 million persons will be added to rural population and 60 million to urban population in the coming 25 years.

5. This ratio will have serious implications for rural economy on account of low man/land ratio. In order to release the pressure on rural economy from the burden ofsurplus non-agrarian population, urbanisation may increase at a higher rate, accentuate higher densities, lower per capita availability of resources-both man made and natural-and generate a serious problems of disposal of large quantities of human and industrial wastes. Besides this, the higher rate of urbanisation will mean serious implications in terms of infrastructure of services, markets, transportation etc. Thus while the magnitude ofpopulation is amajor problem, highly concentrated habitation, will be an additional problem of human health and environment.

6. According to a study conducted by Town and Country Planning Organization, Ministry of Works & Housing, the rate of urbanisation will need to be accelerated to reach a level of 47.1% by 2001. The study stipulated that the per capita income of Rs 55 per month per family member engaged in agriculture will be needed to maintain the present standard of livingby the end of the century. The study has further recommended a major shift in concentration of population from metopolitan city to medium sized city. It is estimated that the number of urban settlements with population above 20,000 will have to be increased from 1023 in 1971 to 4787 in 2001.

7. On the other hand if this population is contained in rural settlements, further fragmentationof land may be undesirable. An alternative to which may be provided through creation of non-agrarian job opportunities for rural areas which will need provision of basic services, amenities and opportunities to a very large number of people distributed unevenly all over the country. These settlements also will acquire certain urban chaeacteristics. The magnitude of environmental deterioration in large cities has reached an alarming stage and calls for a National Action to provide MAN a place of living, working and recreation within his economic reach and lifestyle. One of the major reasons for this degradation is the inadequate and lopsided planningmethodology adopted at present in the country. The ad-hocism of decisions and treatment of problems in isolation are largely responsible for today's urban crisis e.g. traffic in Indian cities is characterised by the hetrogenity of modes of transport (ranging from bullock-cart, hand thelas, cycle rikshaws, scooters, buses, the cars, trucks, bicycles and practically all known modes of transportation) whereas the traffic planning techniques categories it as slow moving & fast moving traffic conveniently converted to p.c.u's. The friction of speed and over-simplified extension of cities connecting two developments of varying time and technology scale have resulted in congestion, suffocation & traffic bottlenecks. Planning techniques for city planning are based on extending into various single use zones, even the norms and standards are adopted are relevant to highly developed car oriented societies and incur high cost of maintenance ofpublic utilities, facilitids amenities & service.

8. Our cities to-day are characterised by :

a) Inadequately of public utilities likd drainage, sewerage, etc. services like water, power, electricity, etc. amenities like public transportation system, communication system etc. and facilities like health centres, educational institutions un-kept recreation areas, parks and play-grounds.

b) Unorganised and inefficient transportation systems.

c) Pathetic condition of slums, squatters and pavement dwellers.

d) Ever increasing urban blight, dilapidated areas and buildings.

e) Unorganised sport developments and extensive derelict land.

f) Deterioration ofurban core areas where majority of the people live.

g) Inadequate and substandard housing coupled with rising cost of development and reduced efficiency of urban infracture.

h) Disappearing landscape features, buldozer architectural and monotonous urban developments.

i) increasing social deteriments like lack of civic consciousness, crime and other evils.

j) Resistance to acceptability of facts of Indian lifestyle, like continuation of rural habits by the new comers in the city.

10. In view of the limitation of land, cost of infrastucture and the magnitude of the population to be accommodated in urban areas, we need to conserve land as a resource while planning new developments. We need to review the possibilities and potentialities of reinforcing existing small towns which may be in a dilapidated condition today instead of developing new towns, An optimal use of existing settlements to an allowable limit needs to be given top priority in our strategy formeeting the fast pace of urbanisation in the country.

11. In view of the above tendencies, the present cities are expected to get over crowded resulting in larger slums, additional squatters, increased traffic problems, decreased efficiency of services and axcelerated growth of social evils. It is imperative that the problems of urbanisation or settlements as such are visualised scientifically in the context of their present state of growth and future possibilities. Some of the major steps for consideration could be :

a) MANAGEMENT : Management of existing settlements based on optimisation models and strategic to utilise maximum allowable existing resources. A system approach is highly recommended for which relevant studies need to be organised. Management in this context will include public services like water supply, sewerage, drainage, transportation etc. amenities - like open areas, schools, health centres., facilities - like hospitals, education centres and utilities - like electricity, power etc. To this must be added management of available land which at present may be derelict, blighted or misused. At micro level optimisation models should also include studies on "mixed land use zones" and organisation of three dimentional net-works of a multipurpose spaces.

b) POLICY FOR POPULATION DISTRIBUTION : Besides National Population Policy, a National Policy for population distribution, location of settlements, production centres of various kinds should receive a high priority in the regional as well as the national context. Futuristic studies for location, organisation and maintenance of new settlements in various socio-economic-cum climatological regions of the country should be undertaken.

c) STRUCTURING OF THE SETTLEMENTS : In structurring old and new settlement, high consideration must be given to three-dimensional spatial structurring bearingin mind a human perspective in varying social patterns and involvement of the people. Perspective model could be developed as a result of urban structure net works, with values imparted from the intensity of the type of activity as an exponential system inherent in urban organisms.

12. In view of activity patterns and intensity matrix high priority needs to be given for evolving energy conserving urbanisms utilising/recycling techniques emphasising compact, aesthetic and viable living environment which is easy to maintain. A masstransportztion system needs to be emphasised in future settlements system.

13. The planning techniques, methodologies, norms and standards prevalent today need a comprehensive review relevant to Indian socio-economic and climatological realities. Similar change is badly needed in administrative and legislative aspects of planning and development. New viable and relevant mechanism for financing, innovating and implementing the results of basic research needed to initiate in ongoing process of continuous learning & improvement before getting stuck with given situations in future.

A BACKGROUND NOTE ON URBANOLOGY

By

Dr. Rashmi Mayur*

Since urbanisation as a way of life is gripping an increasing number of people in India as well as in other parts of the world, it is important to understand the process and its implications and give it a direction for a viable future. Despite the fact that there are 120 million people living in urban areas out of 605 million in the country, India suffers from over-urbanisation. The urban growth is at the rate of four per cent a year and it is fairly reliable to project 335 million people in urban areas out of one billion by the end of the century.

Already many cities are breaking at the seams, inundated by colossal problems of meeting demands of large agglmerations. Unless some r adical steps are taken to control the runaway population and over extended urban centres, there is no hope of retrieving the society from the ultimate disaster.

Hence it is suggested that the Futurology Panel on Urbanization should examine the following steps scientifically and design practical models which would influence policies for a survivable future. Urbanization is a powerful force in every respect. Its future will determine developments of the rest of the country.

The subjects to be examined systematically and scientifically are as follows :-

1. Population
2. Resources
3. Technology
4. Information Systems
5. Policies
6. Management

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....2.

Concerning each one of these topics, we should ask some relevant questions andproject their answers upto a manageable future. Here are a selected questions : What should be optimum population in the urban areas? How do you control it? What should be the priorities of urban planning? What modifications in the urban government are necessary for efficient functioning of urban areas? How do we control the urban exploitation of the rural areaw? How do we distribute the benefits of urban society to our villages? How do we generate urban resources? What type of information should we generate for planning urban areas? How should we assess and select urban technology? Who benefits from the techniological development today? What are the consequences or urbanisation of the environment? Which policies would bring successful urban planning? We can ask several more such questions relevant to our inquiry concerning the urban future.

Unless one is self-complacent or one is befooled by slogans, the urban system is failing and failing at investigate the causes of failure urgently and design mechanisms for reviving hopes for cities, towns and the country as a whole.

POSER OF TOPICS ON URBANOLOGY

by

Dr. J.K. Sridhar Rao and A.M. Nafday,
(NCST Secretariat, Department of Science & Techn

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Brief remarks:

Futurology (Forecasting and assessment) as a process embraces these roles.

(a) Identifying policy options
(b) Aiding strategy formulation
(c) Identifying program options
(d) Selecting opportunities for funding
(e) Perspective Trees (These are a form of relevance trees)

These identify policy options to inter-relate sets of social, economic, political and technological forecasts Before this is done, Objective Trees are drawn to structure program options fo selected strategies. It would be helpful to identify barriers i the concept of "goals - barriers-starting points" as a structur of alternates of alternates. Since a city is a living system, the metabolism of urban areas of various size ranges in terms of inputs (materials, energy) and output (including wastes, pollutants, in addition to goods, services etc.)

Part 1. Introduction (Macro considerations)

1. Problems of Urban growth in India, nature and likely consequences (a historical and futurological perspective). Functional Analysis of role of cities/urban areas in national development viz-a-vis rural areas and balanced regional developm

2. Various approaches to solve these problems, choice of a given approach (i.e., systems approach) and mechanism for integrating the holistic approach to present practices (at different levels

3. Objectives of the Futurology group on Urbanology

Contd........

4. Plan of study/Action Programme

(a) Collection of data on different aspects of urban life and life styles-changing social and cultural values, special goals

(b) Rural and Urban relationships for balanced regional development-various concepts. Preferred Vs probable futures.

(c) Test of data, analysis, projection of trends for 1985 and 2000 relating to goals, Means, agents of change and Framework., Population, Resources, Economics and Management pattern in the future.

(d) Identify problems relating to policy, performance levels, productions (physical targets including qualitative indicators) and processes.

(e) Alternate Solutions : Policy and programmes

Alternate Concepts

(f) Selection of futures (Inventing futures)

(g) Recommendation of appropriate action plan for their implementation. Analysis of (i) Situation (ii) Identification of key problems, physical targets, qualitative indicators (iii) Strategy (iv) Planning and Design (v) Implementation (vi) Management and Administration regulation (vii) Feedback and Information system.

(h) Possible operational Approach by NCST Sub-group on Futurology :

i) Basic studies needed in different areas of Urbanology

ii) Structure of Goals and objectives, Commitments, Issues and Priorities

iii) Priorities , Alternatives in Policy Formulation-Issues in formulating an Urbanisation policy.

iv) Framework for survival - Urban Environment, Quality of life and survival mechanisms

v) Appendix (C) & (D) to design framework suitable for Indian conditions

PART-II BASIC CONSIDERATIONS

(A) PHYSICAL (ARTIFACTS)

1. Land use, density, physical planning in general and its relation to agriculture, Ecology and physical Development

2. Transportation networks (Land, air and water) Structure, regional Connections, growth patterns

   Other networks :- power, gas, telephone lines, water supply & sewerage

3. Housing: general conditions, functional efficiency, patterns, safety and security

4. Industrial areas: Hierarchy of industry and service Sectors

5. Commercial areas

6. Institutions in Urban areas for planning, Management Information and Regulatory Systems

7. Slum areas Squatters - Marginal Settlements (Inadvertent cities)

(B) NON-PHYSICAL (VALUES)

1. Demographic - population growth, patterns, movement age group composition, spatial distribution, Economic distribution and social disparities

2. Social and Economic - Composition of various sectors in urban economy, occupational distribution, educational attainments, income, tax base, religion community language wise distribution, poverty, analysis of poverty among various classes and income distribution - past, present and preferred futures, unemployment, basic values, social organization, economically weaker sections.

3. Administration, Management and its interaction with political processes, public participation in urban affairs, organizational structures & administrative practices (in different time frames considering different projections of realities, resources and uncertanities)

4. Envifonment - quality of air, water, recreational afeas, waste and waste disposal.

5. Political Processes and Public Participation/ Response : New enforcement mechanisms.

PART-III ROLE OF SCIENCE ANDT ECHNOLOGY AS MEANS OF CHANGE IN URBAN SETTLEMENTS IN REGIONAL/ NATIONAL FRAMEWORK.

1. Planning, standards, effective & efficient plans for services, Infractures, networks, information and feedback, cybernatics for hierarchy of human settlement.

   (a) Metropolitan areas
   (b) Developing cities and Towns
   (c) Development of New Towns (including Market, community towns)
   (d) Growth Poles as nucleus for future development
   (e) Hierarchies of settlements-various possibilities in a regional framework (Resource Region Geographic Region)

2. S&T (Food, water, shelter, energy, Transport, Communications, sanitation, Resource Conservation, Ecology, Physical Planning, wastes Disposal and Recycling).

3. Resource conserving Urbanology (Materials and Energy). Alternative concepts for urban design/development. /and

4, Urban structuring and Transportation.

5. City as a system and part of Regional systems. Development of Systems frameworks for integrating various activities in the city, region for Regulation, control and evaluating progress and efficiency.

6. S&T in terms of effective information and feedback systems. Development of effective cybernatic systems.

PART IV. POLICY FORMULATION AND OPERATION MECHANISMS

1. Goals, Objectives, Constraints, Priorities, opportunities.

2. Models for Indian Conditions.

3. Manupulative Variables of Socio-economic development (Agriculture, Industry, Transportation, Communications Urbanization)

4. Altemate concepts, approaches and future (probable & Preferre : For example : (1) concept of the Natural Environment as a control system.

2. Minimal disturbance concept for Natural Environment physical development system for economical design of services.

5. Framework of policy and effectiveness of policy, overall plan, statewise & local plans, databank

6. Implementing agencies, design of suitable agencies, cybernatics and feedback (various time frames-spatial population range frames)

7. Guidelines for future Indicators of quality of life, performance functions and efficiency of a city. Energetics of city activities and transportation system.

8. Future possibilities in areas of social sciences (social Organization, socio-economic growth, Political processes, public participation in urban affairs) organisational structures & Administrative Practices.

PART-V. SUPPORT OF IN-DEPTH STUDIES

PART-VI. APPENDICES

A. Case studies for (past, present and future trends)

   a) Urban region
   b) Metropolitan area
   c) Developing city and town
   d) New towns
   e) rapidly urbanising rural area

B. Functional areas in Urbanology

C. A comprehensive framework for Evaluating policy meqzures for the Urban Environment (To design the same)

D. Spatial policies and Indicators for Urban Development statement of Goals, problems, objectives, indicators, and measures for Utility system (in urban Infracture) in India. (To design the same)

Comments on the paper 'National Population Policy and Urbanisation' from T.C.P.O.

By

Santosh K. Ghosh*

The paper prepared by the Town & Country Planning Organization is thought provoking and it deals with national policies on urban settlement for which vigorous planning efforts are necessary. It is true 'Urbanisation forms an important factors for promoting and sustaining economic development' but very little has so far been done.

Some of the ideas and statements are eithdr incorrect or not clearly explained. The argument in favour of accelerated urbanisation is oriented to mature urbanisation which took place in western countries due to rapid industrialisatio Indian metropolis suffered from immature urbanization due to mass migration from rural areas resulting serious environmental problems and deficiencies in housing and transportation etc. with severe socio-economic problems of unemployment, poverty, urban disease etc. If the first one is technologically supported urbanisation' the second type can be termed as 'socio-economically handicapped urbanisation'. Table 5 giving components ofincrements of urban population shows that the increase in urban population by migration shows that the increase in urban population by migration is much more. Due to the immature urbanisation, the rate of formation of slums in cities is directly proportional to the rate of growth ofbig cities. It can be estimated that number of people who have been provided decent housing and plorts in planned new towns and housing estates during the last quarter of a century is less than the number of people who have settled themselves in pavement, slums and squatter colonies.

In India's context, new urbanisation must be based on agriculturalisation also. Modernisation and development of agriculture will require institutionalarrangement, new marketing and transport and service centres and similar facilities. All these will require urban services, as these are "urban activities". Some amount of industrial development should be oriented to agriculture production in manufacturing equipment etc. If we want to make a balanced development of the country and region with higher standards of living and hierachial distribution of market towns (75 to 100 sq. mile zone as mentioned in a NCAER research report) will be required with infrastructure network of transport, power etc. which will in their turn will be connected with the urban centres. Though considerable advantage can be taken of agglomeration economics, but such advantage always been in industrial production. In the paper a model has been suggested and "the basic assumption takdn here is a smaller proportion in high size towns and higher proportion in middle size towns" (p.18 and also table 6). As such it is doubtful to accept this assumption when considering agriculture based urbanisation. If we accept then we accept also the disparity in living standards, also.

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In big cities one fourth of population lives in temporary housing in slums, and in medium sized and small cities to half of the housing is 'kutcha' or temporary and one third of cities and towns is unsewered and only 50 percent of roads are metalled. Therefore, intermediate urbanization in smaller and medium sized towns and market towns is to be developed. There is an increasing growth rate in tertiary sector its relation to urbanization has been overlooked.

The TCPO report says (p.12) "This pattern of urbanization aims at 47.1 percent urban population by 2001 i.e. 445 million out of 945 millionof total population". It has also been stated (page 6) that percentage of urban population has increase only 9.1% in last 70 years. (though absolute number is more). It is doubtful whether without going through intermediate level of urbanization, this 47.1% can be reached.

Once a U.N. report tried to make a distinction between urbanisation and urban growth, urbanization refers to the growth of population living in urban places relative to the country as a whole - a macro consideration. The growth of individual cities and towns is a narrower andmore specific observation of the specific location of growth.

With the existing planning gap between the macro level of socio-economic planning and micro level spatial physical planning TPCO report unfortunately laid emphasis on urban growth policies rather than population distribution and urbanisation policies.

The approach is sectoral as sectoral planning is very much dominant in National and State economic plans, five year and annual plans. Allocations are made against Deptts. and ministries. There are many area development authoritids and companies and corporations who are encouraging "corporate planning" and there is no spatial dimension of five year and annual plans. Though the exercise on district planning or multilevel planning has been effectively startdd since a few years ago, these are at macro level. There is not a single state urbanisation plan today and there is increasing gap of communication between economic planners and town planners, incharge of urban plans and administrators/engineers in charge of programmes and projects.

In 1971 majority of States have urbanisation level below 15% of total population. Ecluding West Bengal entire Eastern India has urbanization below 10% and in West Bengal if Calcutta Metropolitan District is excluded the urbanization level is not more than that level. There is an unbalanced distribution within each States with large pocketd of backward areas. If a balanced development is desirable and 47.1% urban population is predicted though an average means rich areas will be richer and the poor area poorer. Reference can be made to various analytical studies of Gunner Myrdal, the Swedish Economist.

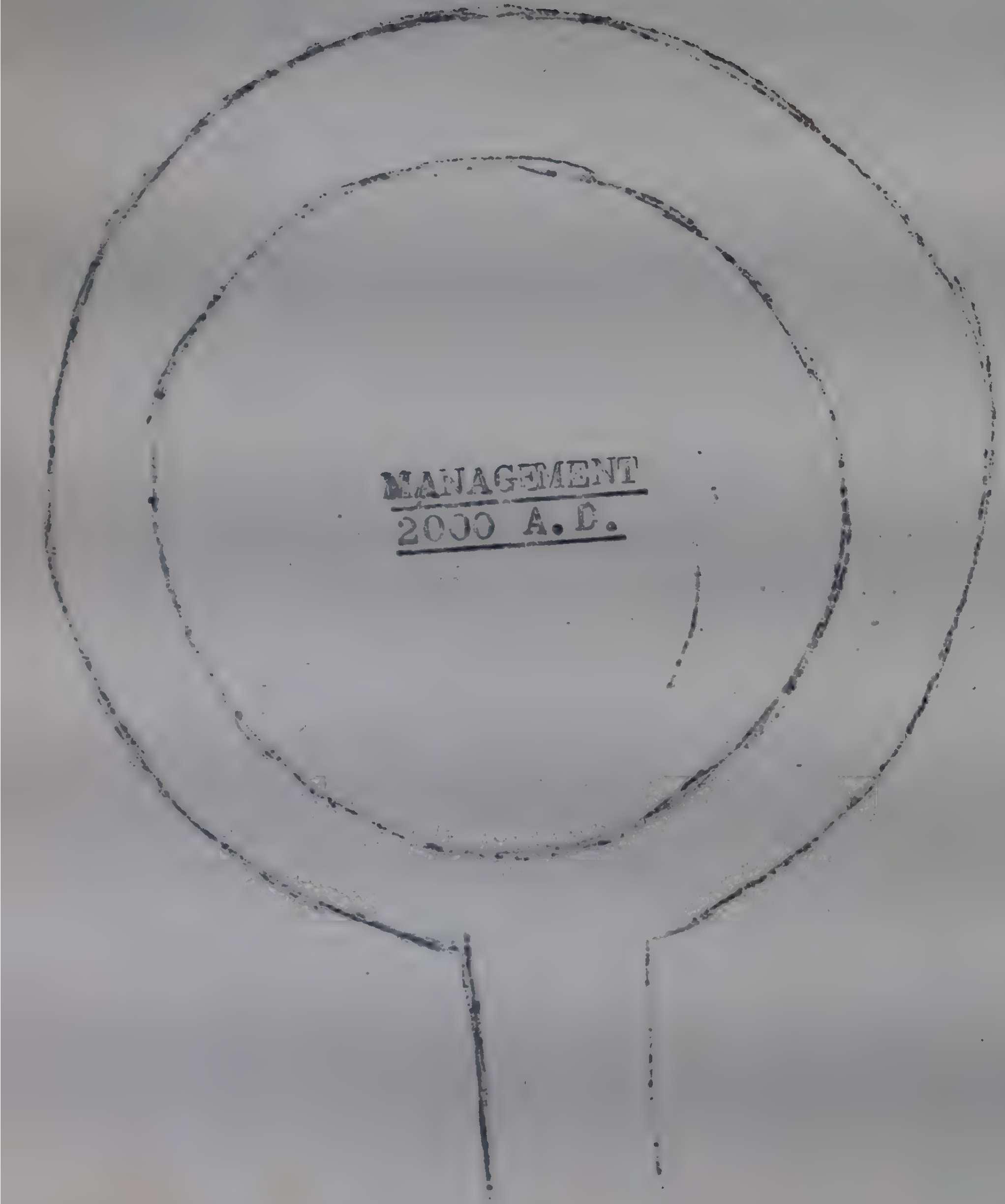
The TPCO's obsession with physical planning of urban areas can be seen in this paper also and demographic aspects evershadows other problems. Urbanization policy can only be cussceesfl only if it is within the framework of socialist and economic development of parties. Though some references are given, there are mostly secondary in the report, urbanisation with relation to economic activities in primary, secondary and tertiary sector, their balanced distribution and other spatial regional planning are important elements in policy formulation. We can no more afford cities in Indian economy as an oasis in rural poverty. Urbanization is thus a process not a product.

It is the totality of planning which would create the framework within which detail policies and programmes are to be developed.

We have a high population resource and low level of technical knowledge but previously we were adopting technology of countries with less population resources and high level of technological knowledge. Instead of an important strategy of urbanization we need multitier process of human settlement.

The details of future policies and programme framework will be discussed in the urbanology sub-panel of futurology set up National Committee on Science and Technology.

MANAGEMENT



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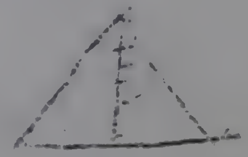
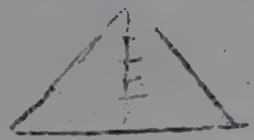
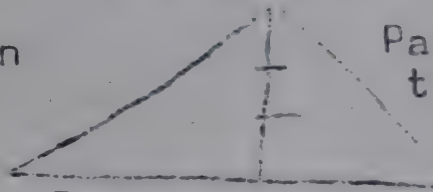
NCST Panel on Futurology

Subject: "Management"

The concern for future is the concern to build a new society. The shifting Management is the key to this developmental task. The shifting scene of managerial practices both in the Government, in the private sector and in the public sector suggest that we are moving in the right direction. If we look at the 50's and then at the 70's, we can see that the emerging scenario of the year 2000 is one of hope as well as that of ample fulfilment. This is not to that we do not face any crisis points. Management of India's resources, the management of men and material and the development of science and technological inputs hold the secret to our future prosperity. We are today 500 million people. We may be around 960 million in the year 2000 A.D. This vast humanity can be our asset. The capacity to organise ourselves and to manage our affairs well can guarantee and provide the right strategies for survival and to ensure a certain quality of life. The Group need to examine the various management parameters as can be seen in terms of the organisation and work style of our personnel and as it concerns itself with the decision making process. Organisational structures, personnel policies, programme content, use of new technologies and tools of management need to be critically looked at with a view to bring about the required reforms. In building a scenario for the year 2000 one cannot escape the temptation to say that Indian managerial force has the necessary vigour, capability, and expertise to prepare for a secure future which guarantee a state of affairs where the right man is workin at the right job with the right technics to ensure conditions in the country where food is available for everyone; and our peopl possess appropriate skills, can get employment as they are and where they are; can generate wealth in its numerous forms; and the discrete use of known technologies both indigenous and thes which characterise a post-industrial society, are able to inst right management systems to deliver the goods in time. It is hoped that this Group's deliberations will not only highlight t aspects but will also offer appropriate guidelines to the polic makers.

Draft Outline Note for the Technical Sub-Group on "Management" of the Futurology Panel

MANAGEMENT IN GOVERNMENT

Parameters examined	50's	70's	2000 A.D.
1. Nature of Bureaucracy	 Too hierarchial Monolithic	 Increased Specialisation More participation.	 Participative Team work less-hierarchic Broad-based
2. Work Methodology. 3. Organisational Structures. 4. Personnal Management 5. Training Function. 6. Reforms Function 7. Decision making process.	1. Characteristic Weberion typology (W.T.); establishes rational legal bureaucratic order. 2. Impact of British Administrative System. (1) Executive part and parcel of legislature. (2) Doctrine of Ministerial responsibility. (3) Politically neutral civil service. 3. Limited Functions (1) Law and order (2) Limited development functions.	1. Webrian typology gets enfeebled (W.T.) as State functions multiply. 2. Administration still tope heavy; limited extension of delegation of powers. 3. Decision making process heirarchical and still precedent oriented. Consultative aspect dominates. 4. Proliferation of Governmental responsibility gives birth to new formations. 5. Influx of specialised personnel.	1. Gradual crumbling of administrative pyramid leading to shrinking of policy levels and concomitant proliferation of programme executing organisations. 2. The character of decision making alters with the increased delegation of authority and due to in work-style. 3. New administrative ethos lays emphasis on targets; time bound programmes; greater facility in implementation policies. 4. Flow of personnel from industry to Government and vice-versa. 5. Increased lateral entry.

50's

(3) Slow moving work style.

(4) Highly pyramedical structures: monolithic top heavy.

(5) Personnel selection: traditions prevails: competitive examinations continue.

(6) Selection process non-related to candidate's specialisation.

4. Training Function

Limited in character.

5. Reforms Function

Beginning of O&M exercise. Early emphasis on statistical study of work-load.

6. Decision making process

Heirarchical: limited delegation of authority; overwhelming concern for precedents; decision making highly consultative and therefore time consuming; highly backward looking too: Historical orientation dominates.

7. Commencement of planning.

70's

6. Training function increase as well as reform function gains momentum.

7. Work study, operation research, new technics begin to receive attention.

8. The continuation of planning process alters the decision making process in various organisations.

9. Project management and role of consultancy increases.

10. Heirarchical attitudes & approach continue to dominate the secretarial work.

11. Growth of S&T organization & emergence of short range & long range S&T Planning.

2000 A.D.

6. Likely crisis in personnel management due to proliferation and diversity in the conditions of service of different types of personnel.

7. Likely emergence of parity in personnel policy as amongst different functionaries/services etc.

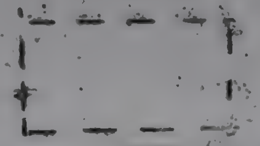
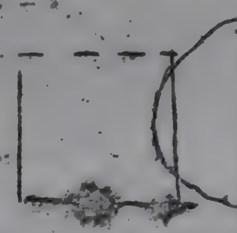
8. Emergence of S&T institutions leading to new approaches to programme fulfilment.

9. Emphasis on task forces/groups/teams as against vertical heirarchical decision makers.

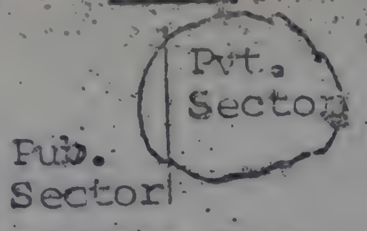
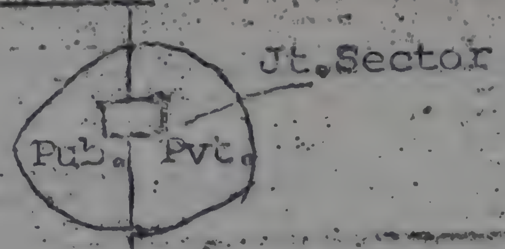
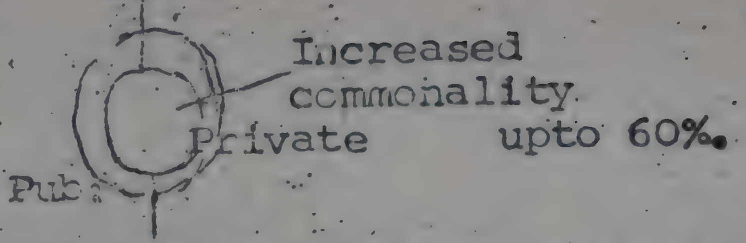
10. Strengthening of management and cooperative sector.

11. Emergence of new styles of rural development & District administration.

12. Emergence of new administrative culture accompanied with attitudinal change.

Parameters examined	50's	70's	2000 A.D.
1. Organisational style	closed sector	 More Open & Exposed to professionalism.	 Participative with public sector.
2. Personnel policy	1. Family owned concern. 2. Role of managing agencies. 3. Foreign collaboration and emergence of multi-nationals.	1. Emergence of professionally qualified people. 2. Managing agencies abolished. 3. Strengthened emergence of multi-nationals. 4. Increase in professionally qualified personnel.	1. Increased participation in management. 2. Better industry-Government relations. 3. Increased role of multi-nationals; greater Indianisation. 4. Increased emergence of the joint sector.
3. Programmes.	4. Lack of management training. 5. Personnel management highly personal and subjective. 6. Lack of social purpose.	5. Claim of social purpose made. 6. Increased management education and training effort. 7. Diversification of industrial activities. 8. In-house R&D, O&M, Operations research and adoption of new management technics. 9. Emergence of joint endeavours with public sectors. 10. Better industrial relations 11. Emegence of professionals in sales, marketing, public relations etc. & allied managerial tasks. 12. Increased Delegations of authority & decision making ability to lower functionaries.	5. Increased R&D effort. 6. Increased meritocracy. 7. Crisis situations arise from resource scarcity.

PUBLIC SECTOR VIS-A-VIS PRIVATE SECTOR

Parameters examined.	50's.	70's.	2000 A.D.
1. Management Style 2. Personnel Policy 3. Training functions. 4. Decision making style. 5. Impact of engineering and allied S&T discipline.			
	1. Narrow public sector base. 2. Rigid demarcations between private and public sectors. 3. Emergence of new defintions concerning the role of public sector. 4. Third Plan decides public sector should make profit. 5. Implementation of Industrial Policy Resolutions leading to increase in the public sector activities. 6. Work style still hierarchical 7. Slow impact of professionalism in the field of project management marketing of R&D etc.	1. Increased proliferation of public sector undertakings. 2. Phase of revaluation of work strategires personnel policies, industrial relations in public sector. 3. Emergence of joint sector. 4. Greater intercourse between private and public sector - both professional & commercial. 5. Project management evaluation technics strengthened. 6. Increased emphasis on R&D.	1. Public sector andprivate sector cooperation increases to 60%; greater collaboration, exchange of personnel and joint activities. 2. Training and management sophistication increase. 3. Time-bound programme take upper hand. 4. Great increase in research, development and design activities - with the emergence of several in-house R&D units. 5. Free flow of ideas and trained managers from one sector to another.

PRIORITY AREAS OF MANAGEMENT'S CONCERN FOR 2000 A.D.

1. Role of management in service sector; increased emphasis in fields like Transportation, Communications, Hospital (including population control) and Tourism, etc.
2. Emergence of S&T institutions; problems of management of running laboratories and R&D management in general.
3. Increased managerial inputs introduced in the field of water, agriculture and energy management.
4. New approaches in university administration; non-heirarchical
5. Emphasis on "ad-hoc-cracy versus bureaucracy".
6. Emergence of non-heirarchical organisational structures.
7. "Free mobility of personnel from Government to Education, from Education to Industry, from Industry to Government and so on..
8. Overhauling of defence management.
9. Adoption of post-industrial technology leading to diversified management styles.
10. Emergence of new management systems relevant to Indian conditions involving community participation.
11. Introduction of management education in school curriculum.
12. New Trends in Managerial Life Style..

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N.C.S.T. PANEL ON FUTUROLOGY

Subject: Management of S&T Institutions : Some issues

by

Dr. S.C. Seth*

1.0 It is suggested that in order to meet the Science & Technology challenge of the coming decades a certain degree of overhauling of the management style and management structures of the scientific and technological institutions is necessary. Although a long tradition establishes certain basic administrative structures and work processes in the Government of India, nevertheless, challenges that face us in terms of the altered circumstances (Plans, goals, targets, new programmes, etc.) compel consideration and acceptance of a new style of work, and necessitates a restructuring of the organisations, particularly, those concerned with science and technology in its manifold aspects. These changes are needed both in the formal and the informal working of these organisations.

2.1 Many views have been expressed by various bodies and individuals. This sub-group can, of course, benefit itself with the suggestions offered from time to time such as the various recommendations made at the Third Conference of Scientists, Technologists and Educationists and the corresponding available recommendations made by the ARC, and its study teams. In addition, we can also lock at those departments who have, of late, ~~are note~~ made several administrative changes such as the CSIR, ICAR, etc.

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* Member-Secretary, NCST Panel on Futurology and Convenor, Technical Sub-Group, Futurology Panel on Management.

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2.2 In so far as the individual opinion is concerned, Dr. Valluri, Director, National Aeronautical Laboratory, Bangalore, has in a paper remarked as follows :-

> "We have to accept that there can be as many varieties and patterns of management as there are individuals who have the responsibility to organise research administrations. I think there is nothing to be worried about which particular management technique is used provided the targets have been achieved. This is not to say that there are no principles to guide the management of scientific research. The important thing to note is management cannot become an end in itself but it means to an end and what ultimately counts is the ability of a laboratory to deliver the goods."

2.3 Apparently, all this holds good not only for the management in laboratories only but is equally valid to the management of other departments who have to discharge scientific and technology obligations. The raison de etre of all changes that we can think of has to be examined in the light of the organisational goals.

3.0 Our paramount concern is thus with the introduction of a new management ethos which may accommodate a certain amount of flexibility in the management of scientific tasks so that we are able to undertake larger tasks than we have been doing so far. This obviously necessitates that to begin with we give a good look to our procedures. Dr. Valluri has the following view on this :

> "The procedures that were initiated 20 years ago, when the science base was being developed would not be any longer appropriate to meet these needs. It is necessary for the scientific laboratories to take the initiative in spawning new technologies in our country."

He further adds :-

> "I do not believe we should become slaves to absurd rules. Rules are made in order to obtain a certain measure of uniformity in our procedures and a certain measure of reason in our actions. But they should not make us forget that the fundamental purpose of all rules is to enable the individual scientists and the research laboratories to function efficiently. I believe, we should not hesitate to change rules if the rules do not serve our purpose in a meaningful manner."

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4.0 Another aspect which deserves equally important attention is the manner in which we can improve the personnel practices now in vogue in the scientific departments. This would necessitate giving a hard look at the problems firstly of recruiting the right person to discharge numerous "narrow" S&T specialities; and, secondly that of providing them with a "career". We cannot overlook that the paramount needs of the R&D workers of today necessitate that they work in conditions which have ample scope for showing their initiative on the one hand and are given jobs which have reasonable promotion prospects. Until and unless these conditions are met, it will be difficult for any S&T institution not only to retain the best scientist or technologist but also to create conditions of service which may facilitate the return of scientists and technologists who are now working overseas. The sub-group while examining the conditions of services would, inter alia, also take a look at establishing relativities, and of introducing better appraisal systems for merit assessment.

5.1 Amongst the numerous obstacles that face the scientific departments one, which stems foremost, arises from the consultative system which characterises Government's decision making process. Today, we have given to ourselves an administrative structure in which certain decisions can be taken only after a due consultation has been done; examples being consultation with DGS&D regarding purchase of equipment; consultation with the Ministry of Law for legal matters; and, for recruitment consultation with the UPSC etc. Whereas in the decision making process no one can deny the inherent merit of such an approach, nontheless this consultative style is a bit out-moded considering the bewildering range of functions that a scientific department has to discharge and has to do in a framework replete with time-bound targets. We, therefore, need to have a new style of decision making in which history plays a relatively minor role. There is thus need for discussion how we can streamline the existing consultative procedures and provide for sufficient delegation of power.

6.1 This sub-group can also look at the strategies relevant to carry out programmes included in our plans. It is all the more important when we have given to the country a National Plan for Science and Technology.

6.2 The members of the group are aware of the various problems that different organisations face from time to

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time in the field not only of planning but also of plan execution. It is not our intention to suggest that the approach and style prevalent today is obsolete. What we have to consider is how best can we identify the right and wrong administrative practices so that the plan performance of the ministries, concerned with the implementation of S&T Plan can be stepped up in terms of the pre-determined priorities. The plan execution call for a total integrated systems-approach wherein the institutions have the necessary freedom to mobilise their resources and manpower. Amongst other things, thus the sub-group needs to examine the character of the day-to-day functioning which probably is the single most-important element for undertaking any administrative reform of the scientific departments.

7.1 Finally, it would also be necessary to develop norms whereby a judicious combination of the administrative support arrangements that the scientist need in order to be able to show initiative in their work. Here again, we will have to consider how best the existing administrative support structures can be recast so that the scientific institutions are not hampered by now-familiar bureaucratic practices and accompanying bottlenecks.

8.1 To sum up, this sub-group needs to discuss the following aspects :-

(i) Do the scientific departments dealing with general science & technology or specialised sophisticated technology (BARC, Space, Electronics, etc.) Agriculture, Public Health, Industrial Research & Development, Resource Management (Water, Energy, Forest) or specialised services (Meteorology) etc. require a new management ethos? If so what is its character both as regards the formal and the informal aspects of such organization.

(ii) Should our S&T institutions have a different set of work procedures, primarily to up-date our technological base and secondarily to modernise Indian R&D Management?

(iii) In the process of S&T Planning what are the approaches and systems that need to be developed so that these institutions can focus their attention on 2000 A.D. on which R&D activities can commence now?

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(iv) Should the scientific departments have a different kind of decision making process? If so, what norms can be laid down for it?

(v) What should be the method of recruitment, selection, placement, assessment and promotion which may help retention of the best personnel?

(vi) Is there ample delegation of authority available to S&T functionaries to ensure enough scope for display of initiative and to ensure that S&T targets are met with speed and in time?

(vii) Finally, what would be the judicious mix of administrative support and scientific freedom that a functionary or a team of S&T functionaires need?

CO-OPERATIVE MANAGEMENT - 2000 A.D.

- A Scenario

by

K.K. Taimni*

Widespread misgivings about their performance and general decrying of their alleged failure to come up to the expectations of the community not withstanding, the cooperatives are destined to emerge as dominant undertakings in such vital sectors of the economy as agriculture; industries like sugar cotton yarn; handloom cloth; public distribution of essential commodities, fisheries housing, etc.

Apart from the state policy and the particular socio-economic environments in the country, several other factors - voluntary effort, mass participation, social control, harnessing of local initiative and resources and above all institutionalisation of flow of essential commodities, tend to make cooperatives ideal institutions to help achieve the policy objectives of the state and its planning apparatus.

Cooperatives dominate one or the other secotor of the economy in almost all countries of the world. Even in countries with centrally planned economies, cooperatives have demonstrated (and therefore have an edge over state owned agencies) that in certain sectors of the economy; agriculture, retailing especially rural retailing, housing, etc., these can and do perform better than any other agency. In other developed economies, cooperatives have traditionally occupied dominant positions in several areas.

Thus at the macro-level cooperative organisation is obviously preferred in a variety of fields and will continue to be preferred by the powers, that be, for attaining specific policy objectives. It is, really the performance at the micro level of these cooperatives, however, that creates doubt about their efficacy in meeting the expectations of the community as well as in becoming live agents of change. Appropriate management systems attuned to their specific requirements can surely pave way for meeting this challenge as well.

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*The author is a member of the NCST Panel on Futurology's Technical Sub-Group on "Management".

Focus of Management

The areas over which the cooperative activities extend and where they are likely to dominate in the future cover such vital sectors of the economy as agriculture - supply of inputs, marketing and processing of agricultural produce, sugar, rice, edible oil, cotton yarn etc. - production of cattle feed and fertilisers, public distribution system; housing; village and cottage industries; handloom cloth, handicraft and fisheries. These, indeed, cover the largest chunk of the population and will reach succour to the more weak and vulnerable sections of the community. The focus of the cooperative management in future will be on these types of institutions.

Size and structure

Hitherto the size of the cooperative unit was small. In fact in the 50's the slogan was "one-village one-cooperative". Large size cooperatives have now emerged in such diversifiedareas as production of fertiliser, sugar and cotton yarn, dairing, retailing, agricultural marketing; rural banking, cottage industries; housing; fisheries, etc. Thus the size of an average successful cooperative is growing and will continue togrow. So indeed will be nature of complexities and therefore the need for appropriate management systems for these cooperatives. The number of units will go down drastically, as a result of amalgamation, rationalisation and weeding of non-viable units.

The cooperatives function today more or less as autonomous unit, at times even as a part of the state administrative apparatus. There ishardly any vertical or horizontal link-up with other cooperatives. In other words, cooperatives do not function as a movement and this has severely impaired the capacity of all types of cooperatives to live up to the expectations of the community. Attempts on professionalisation of management, curbing growth of vested interests, introducing sound personnel policies, making rational investment decisions, creating a community of interest for all types of colperatives in the country, have largely failed as a result of this lack of integration between the apex/federal level and primary level cooperative organisations. On paper, 3-4 tier vertical structure exists for each major branch of cooperatives, yet there is hardly any meaningful organic link between these units at different levels.

This general lack of cooperative intgration has also implied absence of unified common decision centres for different branches of cooperative movement and consequently

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general lack of direction, purpose and community of interest. The Registrar ofCooperative Societies had hitherto played this role of a common decision centre and had for all practical purposes, controlled, directed and supervised the cooperatives in their jurisdiction. But even as the size, complexities and relevance to the community of the individual unit is increasing the hold of the Registrar is also loosening. At the moment, barring isolated instances, the cooperatives are in a transitory stage where they are coming out of the strong grip of the Registrar but have not yet knit themselves into a movement, with strong and powerful federal units at the apex to control and guide their destinies. This transitory period will surely end soon enough to witness a much reduced role for the State Registrars of Cooperative Scoeities especially in the case of large sized complex cooperative unis in the country and a more dominant role of the apex/federal units.

The strongest barrier against rapid shift towards de-officialization of cooperative management hitherto has been the unholy alliance between the ruling political party and the unscrupulous element in the society, who come to dominate the cooperative movement. The cooperatives often prove handy instruments to strengthen the political base of the leadership and also as avenues to distribute official largesse to protege of the political big-wigs. Thus the cooperative leadership at the non-official level often comes from political caders as against monied classes in the past. Yesterday money lenders have apparently yielded place to local political bosses of today in cooperative structure. It is claimed that professionalisation of management is linked to the state of socio-economic development within the society. This might well be the case and one may have to wait for long before professional management really takes over the rein in the cooperatives.

Appropriate management systems, relevant to the cultural environments within the cooperatives will have to be thus evolved. Cooperatives today largely remain unaccountable to any institutional authority either within or without their flexible boundaries.

Organisational Style

Closely linked to the pattern of cooperative leadership is the organisational style and the cultural environments within the cooperative enterprise. Even as the feudal elements in the country-side dominated the cooperatives in the beginning, feudal style of management

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creeped in these organisations. Not that a great change has now occurred. A study of any rural-based large cooperative unit will dispel any doubt about this change. The organisational style remains even today within the autocratic benevolent continuum, and the worker, it is bemoned, enjoys a status that is in no way bettern than a domestic servant or hired agricultural labour in the field. Industrial unrest is rare not so much because of any deep satisfaction among the work force as its utter helplessness against well entrenched all powerful cooperative leadership. The apparent calmness on the surface on the industrial front sits on a volcano of discontent and it manifests itself through general inefficiency and sub-optimum utilisation of resources. Only professionalisation of management, it is argued, may usher in a different and hopefully the acceptable participative style of management.

Decision Making

As was the organisational style so was the decision making process - autocratic in the beginning gradually shifting towards benevolence but essentially based on hunches, intuition and personal biases and experience. In the beginning the size was too small to require anything more polished. But as the size grew, the decision making process remained and continues to remain traditional. There are two essential features of decision making process in the cooperatives. Almost allthe decisions especially in non-technical areas are taken by the boards of directors, which consist of rank laymen, usually elected but also often nominated by government (mercifully technical areas are left to the professionals though talented professionals seldom feel attracted towards cooperative organisations, but then that is a different issue althogether). The decisions by the Boards are not always taken in the larger interest of the cooperatives and the community that they seek to serve. Personnel factors - may be social, political, economic or even self interest - play a dominant role in the process of decision making. The location of units, the investment pattern, recruitment policy, pricing strategies, the product mix, questions of recovery of dues from borrowers, are not always decided on rational, objective and satisfactory basis. This in turn adversely effects the performance of the cooperative unit and its capacity to achieve its real objectives. The quality of decision making has always remained a function of the type of leadership. Attempts towards professionalisation, in one way are really designed to improve the quality of decision making in the cooperative units.

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Personnel Policies

The cooperatives had traditionally relied on honorary workers to carry out the basic mores which such organisations normally entailed and it remained so even when a great many cooperatives increased their operations. Thus for small sized cooperativesthe question of employing workers has always been irrelevent. Not any longer now. Even a rural based service cooperative is now said to be viable only, if it employs whole-time paid secretary. There are, a number of cooperatives which have cut out grown that stage and need and employ a sizeable work foce.

The approach of the cooperatives towards the work foce, however, remains ambiguous. Whereas it is realised by the leadership that the cooperative movement had originally emerged as a movement of protextagainst exploitation of labour by capital and therefore a cooperative should look kindly towards its work force, it seldom does so. Unlike the cooperative movementsin most of the Western European countries, where they are part-workin class, part - socialist in character, their Indian counter-part is part-political, part-capitalist. It provides fertile ground for the opportunitists to achieve their selfish ends. It is this aspect which explains failure of the cooperatives to have a distinct approach towards their personnel.

The other two related aspects of personnel management as are seen today, are heavy reliance on state bureaucracy for manning senior managerial positions in the cooperatives and preference to the 'sons of the soil' and kins-men in matter of employment as against talent, merit and specific requirements of the enterprise. Lack of adequate job security, poor compensation policies, sub-standard working conditions, provision of only such facilities as are absolutely necessary to meet legal obligations, characterise the personnel functions in most of the cooperatives today.

There has also been an endless debate on creating management cadres for key senior managerial positions in the cooperatives. Some steps have been taken here and there but the usefulness of the scheme has not yet been fully established. It is likely that the pressure will build up soon on the state to set up statutory cooperative employees commissions to look after some of the critical areas of personnel management in the cooperative sector, primarily with a view to insulate this critical management function from the interference of non-professionals, who abound in the cooperatives.

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Training

Fortunately, the cooperatives had been concious of the need of training among their leadership and staff from the very beginning. The focus in the initial stages was on training of non-official leaders and the government personnel engaged in the task of organisation, promotion and supervision of cooperatives. The focus gradually shifted and now it is claimed that the training programme is oriented towards managerial personnel of cooperative organisation with a view to equip them with basic principles of general management. The training structure as it exist today, however, hardly encourages one to believe this. It looks as if the training imparted is really in cooperation of which management training is but a small part. It is rightly said that cooperative training institutions are like schools in cooperation which also give training in management.

Sporadic attempts have been made, especially be the apex level sectorial organisation like National Cooperative Consumers Federation, National Federation of Cooperative Spinning Mills etc. to start separate management training programmes for the personnel of the affiliated units. This trend will increasingly be discernable in the future. Therewill be a shift not only from cooperation to management but also from general to specific branches of cooperative movement in the training programmes and unlike as at present when training is conducted by the National Cooperative Union of India, the sectorial apex organisations will offer management training programme relevant and attuned to the specific requirementsof the managerial personnel of their affiliated units.

The scenario which is presented here gives a framework. Intensive studies in each of the major sector can alone help build scenarioes for the specific development that are likely to make demands on management and the types of managerial system which shall be relevant to the needs of the emerging large sized cooperatives of the future.

Cooperative Management 2000AD - A Scenario

Parameter Examined	50's	70's	2000 AD
1. Focus of Management	Supply of agricultural credit	Supply of agricultural inputs, agricultural marketing, agricultural processing, Handloom.	- agricultural inputs, - agricultural processing, public distr bution syste Housing, Handicraft Handloom and other cottag industries.
2. Size of unit	One village one society	Large cooperative units.	Fairly large to gian cooperatives employing 30 to 5000 personne
3. Structural relationship.	Practically none.	Loose almost tenuous	Highly integrated structu Apex-level organisation will control and guide the units at the primary level.
4. Relationship with state administrative apparatus.	Complete control of the State apparatus.	Control yielding to direction by the state apparatus.	Informal supervisio
5. Background of non-official leadership.	Monied sections in the rural areas.	Monied, but highly politicized rural elite.	Political cadres
6. Degree of publication.	Not much	Highly politicized, for private ends.	Highly politicized but for public ends.

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Parameter Examined	50's	70's	2000 AD
Organisational Style	Exceedingly Feudal	Feudalistic patronalistic	Consultative participative
Decision making authority	With state administrative apparatus.	Though within the organisation, but rigid and highly personalised	Dispersed within the organisation and based on objective evaluation.
. Source of personnel selection.	Need was not felt.	Reliance on state bureaucracy and kins of the leadership.	Selective, merit base and highly professionalised
0. Training function.	Focus on government procedures and controls.	Focus on cooperation – theory and practice with some orientation towards management.	Focus on management of cooperative enterprise.

Discussion Note from Mr. D.K. Subrahmanyam

Any institution, e.g., the business enterprise has to contribute a needed result to society, the economy and the individual. Thus the institution is an organ of society. Management, in turn, is the life-giving, acting, dynamic organ of the institution it manages. Management is work and as such it has its own skills, tools and techniques; but the stress is on tasks and not on the work of management or its skills, tools, etc.

2. In striking contrast to the practices in the past, every major social task has been entrusted to large institutions-from producing economic goods and services to education, from the search for new knowledge to the protection of the natural environment in our society at present. If such institutions do not perform in responsible autonomy we will neither have individual nor a society providing a chance for us to fulfil ourselves. Tyranny is the alternative to performing institutions. It is managers and management that make institutions perform, Management, like any other discipline, is an organised body of knowledge but embedded in a tradition of values, customs and beliefs and in governmental and political systems. Management is thus culture-conditioned; but, in turn, managers and management shape culture and society.

3. Institutions other than business do not speak of management and managers. Government agencies have administrators, armed services have commanders and so on. In all of these, however, management is the active organ. The institutions themselves are, in effect, only accounting realities but not social realities. When we refer to an institution we do so to a group of managers within it. Business enterprise was the first of the modern institution to emerge and such enterprises have provided economic goods and services to an extent that would have been unimaginable in 1900. And such enterprises have performed despite two world wars. The reasons are thus historical for the business management to be the focus. Our society naturally therefore looks to business management for leadership.. The society has high expectations based on the performance of business managemant. The foundation of any work in Management has to be business management. The non-business, public-service institutions do not need management less than business. They may need it more.

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4. Economist's traditional view of development as a function of savings and capital investment was not adequate as it became clear fairly early in the postworld war II period that management is the crucial factor in economic and social development, and with it savings and capital investment. The development of management and managers in India has not proceeded fast enough to generate adequate development especially in view of the explosive growth of population.

5. Even before the present management boom, experts were always there who knew the foundations to the management structure. The current management boom has only refined, added and modified but created little. It made accessible to managers everywhere the experience and knowledge of a few experts. It made into general practice what, till then, had been the rare exception. The rising tide of human expectations, an insatiable appetite for new services and new satisfaction - for education, housing, etc. - require massive economic efforts. Without a far higher level of productivity it will not be possible to satisfy these demands. The traditional management approach to labour had to be sharpened to ensure that productivity is the output of land, labour and capital, in balance. The emphasis has, so far, been primarily the management of the established, going business. The management will have to concern itself more and more with creating the new in addition to optimising the already existing. Managers must build and innovate. The need for social innovation may be even greater than for technical innovation. The need for rapid social and economic development, the need for productivity in education, all these are opportunities for social innovation demanding new vision, new work and new knowledge on the part of management. This means that the attainment of the quality of life and the fulfilment of the basic social values, beliefs and purposes will have to be considered an opportunity to be converted by management into profitable business, Japanese practices appear to be worthwhile copying in this connection.

6. The future manager's main concern should be with innovation which endows human and material resources with new and wealth producing capacity and can no more be considered as a function separate from marketing. Innovation is not confined to engineering and research but extends across all parts of the business, all functions and all activities. The systematic purposeful innovation should be a business activity rather than a functional work. Innovation is particularly important

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to a dev-eloping country like ours. We have the resources. We are, however, poor because we do not make these resources produce maximum wealth. Technology could be imported but our managers should produce the necessary social innovations to make the imported technology work. Japan deliberately relied on West's technology until very recently and channelled the energies of their people into social innovations that enabled them to become a strong modern society and economy without their culture being effected in any way.

7. Increased productivity in a modern economy is never achieved by muscle effort. It is always the result of substituting capital equipment, that his, mechanical energy in place of muscle effort. In fact the mechanistic fallacy of Marx was that all human achievement could eventually be measured in terms of muscle effort. As important is the increase in productivity achieved by knowledge replacing muscle effort resulting in a shift from unskilled and skilled labour to knowledge workers such as managers, technicians and professionals. The basic factor in our development must be the rate of "brain formation", the rate of which the country produces people with imagination and vision, education, and theoretical and analytical skills. Planning and designing, before installation and use, is a conceptual, theoretical, and analytical task facilitated by "brain formation" rathern than "Capital formation" which is a secondary factor. The planning, design and installation of capital equipment is only a part of the increase in productivity through the substitution of brain for brawn. Equally important is the contribution made through the direct change of the character of work from one requiring the manual labour, skilled and unskilled of many people, to one requiring theoretical analysis and conceptual planning without any investment in capital equipment. The greatest opportunities for increasing productivity are surely to be found in knowledge work itself, and especially in management. The vocabulary of business-especially in management. The vocabulary of business-especially of accounting - in relation to produc tivity have become so obsolte as to be misleading. The production labour is manual workers tending machines according to the accountant and what he calls non-productive labour includes pre-industrial, low-productivity brawn labour like sweepers; some traditional high-skill, high-productivity labour like toolmakers, electrician, formem, industrial engineers,

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and quality control men. Finally, what the accountant lumps together as overhead the very term reeks of moral disapproval contains what should be the most productive resource, the managers. We need a concept of productivity that considers together all the efforts that go into output and expresses them in relation to their result, rather than one that assumes that labour is the only productive effort, We must develop yardsticks to measure the impact on productivity of the substitution of capital for labour, and of knowledge for both and means to distinguish between creative and parastical overhead and to assess the impact on productivity of time utilisation, product mix, process mix, organisation structure and the balance of activities. Not only does individual management need adequate concepts and measurements for productivity, the economy needs them. The lack of such concepts is the biggest gap in our economic statistics and seriously weakens all economies policy. It frustrates our attempts to fight depression and inflation alike. Contributed value-difference between the gross revenue received by a company from the sale of its products or services and the amount paid out by the purchase of raw materials and for services rendered by outside supplies - can be used to analyse productivity only if the allocation of costs is economically meaningful. Contributed value will not, however, measure productivity resulting from qualitative rather than quantitative factors. Contributed value is strictly quantitative tool. Yet qualitative factors have major impact on productivity. Quality of tomorrow's management is a fundamental factor in productivity, over the short or the long range. However, they elude our existing measurements. Again contributed value can be used, by and large, only in businesses that make something, that is in manufacturing business. Within these limitations the tools of Operations Research should be used for working out alternative courses of action and their predictable consequences. Without proper tools for accurate measurement of productivity there is no control over business. The management should apply its mind to this important area.

8. Till recently the social dimension was considered so intangible that performance objectives could not be set. Consumerism and the attacks on industry for the destruction of the environment are expensive ways to learn that management needs to think through its impacts and its responsibilities and to set objectives for both. The enterprise exists on

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sufference and exists only as long as society and economy believe that it does a job, and a necessary useful and productive one. The social dimension is a survival dimension. Small company needs social objectives fully as much as the big business - through it may need different ones. In view of the awakening of the social conscience the management should appreciate that such social objectives are needed not because the managers have responsibility to the society. They are needed because the manager has a responsibility to the enterprise.

9. The centre of gravity of the work force is shifting from the manual worker to the knowledge worker. As time goes on a larger and larger proportion of the labour force will not work with its hands, whether as skilled or as unskilled workers, but with ideas, concepts and therories. In the Marxist usage of the term they are "intelligentsia". It is not necessary that the knowledge workers should be highly skilled or highly schooled. This change some experts argue, will mean a crisis with respect to manual worker and the labour union. The economic position of the manual worker is not threatened. The emergence of the knowledge worker will diminish the manual worker's social position and status. This is not a result of managerial actions but of social developments and of the pressures they generate. The young manual worker of today will soon develop a feeling of rejection, a feeling of failure, a conviction of being a second class citizen when he compares himself with the knowledge worker. The difference in income and economic positions between the manual worker and most of the knowledge workers is negligible. Knowledge workers are rapidly becoming the majority instead of the manual worker that attend the shift in emphasis to knowledge worker not only create a new class cleavage but also severe difficulties for the manual workers' labour union. The manual worker is likely to resist the union leaders' authority even more than he resists the rest of the bosses. The collective bargaining is likely to get into trouble very soon. It should remembered that the knowledge worker except on the very lowest levels of knowledge work, is not productive under spur of fear; only self-motivation and self-direction can make him productive. These may be the central problem of the new manager. The future will be influenced greatly by the way the manager solves or fails to solve the growing and deepening crisis of the labour unions. To think through the role and function of the labour union is also self-interest for management. It is sheer self-delusion

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to believe that the labour-union weakness means management strength. A case study of the recent prolonged strike at the famous CMC Hospital at Vellore in Tamil Nadu should reveal the tendencies towards such class struggle between manual worker and knowledge worker and the ease with which a handful of manual workers were able to intimate the labour union leadership into prolonging the strike for trivial reasons, causing misery to all concerned. ecause of the lack of will on the part of the labour-union to control their members, the hospital administration became helpless.

10. The new breed of workers will pose a problem to the future manager. They will be eager for more-much more than the economy can produce so far. To make a living will no longer be enough. The rising level of expectations will be the central phenomenon. This means that it will be more important than ever to make work productive. At the same time, both the manual worker and the knowledge worker with his ill-defined status will expect work to provide non-material psychological and social satisfactions.

11. In the field of mechanisation the future managers have to watch out two dangers. Before we discuss these let us see what exactly mechanisation means. Most people believe that it pertains to modern tools of an advanced technology. This belief is not correct. In fact all tools are "mechanisation". Over the millenia we have changed the energy source for tools, from human and animal muscle to wind and water and to fossil fuels and nuclear power. The tools have however changed very little. Tools from the beginning were a uniquely human phenomenon. All tools are extension of man. They either extend the body, as does the hummer or they extend his mind, as do the multiplication table and computer. Or they provide man with capacities for which his own body is not engineered - such as the wheel and axle. All tools are tools of man and must, therefore, serve him in his double need of making work productive and worker achieving. There is a great deal of fear today that modern technllogy is becoming man's master rather than his servant. This fear is unfounded Mechanisation to be properly applied must always extend the sphere of human capacity, must always extend the sphere of human capacity, must always add to man's capacity to achieve. If mechanisation does not do this it will cut down output. Reference was made to two dangers

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to watch out for. The first is the danger of making man a part of the machine. Men are very poor machine parts. If the human effort is misengineered into the system so that it does machine work, the system works poorly. The second danger is to misuse the tool as a divisive element in the work group thus frustrating man's basic need to establish a community bond through working. Man in the traditional automobile assembly line is, in effect, a part of the machine. He does very poorly, very slowly and very sloppily what a machine should be doing. This is the essence of doing one repetitive motion at the same unvarying speed and over and over again. Worse still the automobile assembly line make each man a threat rather than a resource to his fellow worker. If one man on the line works a little faster he threatens his neighbour. Working at his most productive, that is, with varying speeds and rhythms, he becomes a threat to everybody else. He cannot, by working better, help his neighbour. He is confined to his operation. This is not inherent in the assembly line. Experiments with responsibility on the part of the workers for assembly line operations are being carried out in the U §A. If mechanisation that is most conducive to make work production threatens to harm the worker the mechanisation should be re-engineered. The other answer is to transcend mechanisation and move to automation. The best illustration of what automation means is the telephone system. The telephone system does not work "untouched by human hands" nor does it operate without human work. The user, in dialling the number he wants to reach, programs the system. And this is "work". Given these instructions the system runs itself, switches to the appropriate a appropriate channels, returns a signal that tells the dialler whether his call goes through or not and disconnects at the end of the conversation. It also does the ancillary work such as recording the calls for billing purposes. The dialler may be almost totally unskilled, Whether skilled or unskilled the worker dialler is discriminating and his tool is judgement rather than manual or even conceptual skill. Whenever mechanisation reaches a point where the worker is engineered to be a machine part we can design a machine to do machine's work. In other words we can automate. This may not, in a given case, be desirable or economical. We may not even have the technology as yet to do it, but it is always possible. It is not necessarily, a better alternative to re-engineering mechanisation but it is always an alternative that should be taken seriously. Automation is not an arrangement of machines. It is not the ultimate in mechanisation. It can work perfectly without any machines. The abacus, which Japanese and Chinese

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ten-year-old use with high speed and accuracy is, in effect, automation and data processing. Any work needs its tools. Any work, therefore, needs to be mechanised. "The workman is only as good as his tool" and "The tools work only as well as the workman". In designing tools for work the manager has to be conscious of both dimensions, that is, of work and working.

12. Whether we will ever know enough about human nature to have any theories about itremains to be seen. The evidence so far, is not conclusive. One theory assumes that people are essentially lazy, shun work, have to be driven and need both cannot and stick. It assumes that most people are incapable of taking responsibility for themselves and have to be looked after. This theory assumes immaturity. Another theory postulates that people have a psychological need to work and want achievement and responsibility. Perhaps the true nature lies between these two extreme positions. The former theory assumes "master" : but the manager is not a "master". He is a superviser, but he is a fellow employee. For the first time in history we have a society which lacks masters. The manager, not being a master, lacks the master's authority and the master's credibility. Employees are not chief executive's servants; they are his fellow workers. Neither stick nor carrot will work hereafter no matter how well they used to work for the master of old. While the society has changed fundamentally the techniques of management have shown amazing continuity. One does not lightly toss out the tradition of the ages. The future manager must realise that the traditional way of management cuts across all of man's culture. The management must think of some "modern drives" for the old driving force of fear and money. The labour unions have a stake in the coercive relationship between management and labour. When an enthusiastic manager tries to humanise the assembly line, the opposition to the proposal will, most likely, come from labour-union. Psychological despotism practised by a few top bureaucrats and chief executives in business enterprises is a gross misuse of psychology, whole main purpose is to acquire insight into, and mastery of oneself. To use psychology to control, dominate and manipulate others is self-destructive abuse of knowledge. It is a repugnant form of tyranny. There are one or two enterprises in Tamil Nadu who are priding themselves that they have not had any labour strikes. This position has been achieved so far by psychological despotism. The enterprises are bound to face very serious labour difficulties very soon. A manager who pretends that the personal needs of the subordinates for affection, ratherthan the objective needs of the

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of the enterprise, determine what should be done would not only be a poor manager; no one would or should believe him. All he does is to destroy the integrity of the relationship and with it the respect for the person and his function.

13. Power and authority are two different things, Management have only responsibility but no power. And it needs and must have the authority to discharge its responsibilities. But not one whit more. Society will not tolerate any management involving. "Management Prerogatives". A prerogative is a privilege of rank. Management have no claim to any such privilege. It exists to discharge a function. Its job is to make productive the resources in its trust. A prerogative is never based on responsibility or contribution. Prerogative originally denoted "divine right". Even the most autocratic management is unlikely to claim divine right. Also management has authority only as long as it performs. Managements who refuse to demands responsibility from the members of the organisation are actually losing necessary authority, especially to the labour union and to government. Managers of business are by no means alone in their confusion of power with authority. Indeed, managers of business by and large, have been more willing to work on building an achieving a work force than administrators of public-services institutions. The administrators in Government have been even more reluctant to make their staff responsible and are depending more on their prerogatives rather than on the authority appropriate to their responsibilities. As a result they have actually lost true and needed authority and are having very great difficulties in getting work done. Our Prime Minister appera to have paid in a recent communication to her cabinet collegagues that quality of services to people in the post offices, railway stations, police stations, treasureis etc. has gone down considerably. The Prime Minister's concern is for both the people who suffer and the bad name the Government is getting in the process. The Government departments have been growing much faster than business enterprises. Performance has not kept up with growth or importance. The Government department is different fundamentally from business in its "business". It is different in its purpose. It makes a different contribution to society. Performance and results are quite different in a Government department from what they are in a business. Managing for performance is the one area in which the Government department differs significantly from a business.

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14. Closely linked to the confusion of authority with power is the resistence to decentralisation. The fear that decentralisation would weaken top management and lead to "top management ablication" is baseless. Some of the defects connected with business performance could be remedied by decentralisation which actually strengthens top management, which is made more effective and more capable of doing its own task. It actually results in greater authority for top management. It must be stressed here that decentralisation does make high demands on top management and this fear the real reason for top management's resistance to decentralisation. The management should be prepared to meet the very high demands that will be made by responsible work force which will require a manager who is complement as manager and not as psychologist. The new work force is sure to demand that managers take their work seriously and they themselves take responsibility for their jobs and their performance.

15. A very important area that will assume very great importance as years go by relates to the impacts of the management's activities on people and on the physical and social environment. The management will be increasingly expected to anticipate and resolve social problems. New policies have to be developed for the relationship of business and government. The new concept of social responsibility demands that business take responsibility for social problems, social issues and social goals. Increasingly such social responsibilit is also being demanded of non-business institutions such as Universities, etc. apart from government agencies. The demand on business for social responsibility is, in large measure, the price of success. The society, hereafter will increasingly look to business enterprises to take on the social problems which the government should but is not able to solve. Social impacts should be differentiated from social problems. Social impacts are incidental to the purpose of the business enterprise. Social problems by contract are dysfunctions of society. There is no doubt about the management's responsibilities for the social impacts of its business. Because the management is responsible for the social impacts it should not minimise them. It should be pointed out here that impacts which are not essential to business should be kept to the absolute minimum even if they appear to be beneficial to society. Such impacts will sooner or later be resisted and be considered impositions by politically inspired groups of the society. Impacts always carry within themselves a cost and a threat. The cost is non-productive.

16. The job of management is to identify and objectively anticipate impacts, and realistically, especially of new technology at the time of its introduction. This may be termed as "technology assessment". Impacts and side effects of new technology should be anticipated before going ahead with it. It is well to remember at this stage that

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it is impossible to predict what technology is likely to become important and have an impact and what technology will either fizzle out or have minimal social and economic impacts. And which technology will have social impacts and which will remain just technology is even harder to predict. Economic and social prophets have the most dismal record as predictors of technology. The "private flying boom" which the experts predicted shortly after world II never materialised. A few years later everybody predicted that automation would have tremendous economic and social impacts - it has had practically none. The computer offers an even odder story. In 1950 nobody predicted that the computer would be used by business and governments. Everybody "know" that its main use would be in science and warfare. As a result, the most extensive market research undertaken in 1950 reached the conclusion that the world would be able to absorb at the most 1000 computers by the year 2000. Now in 1975 there are over 15,00,00 computers in the world, most of them doing the most mundane book-keeping work. When, in the early 1950s, it became apparent that business was buying computers for pay roll and billing the experts predicted that computer would displace middle management so that there would be nobody left between the General Manager and the foreman. Anyone depending upon technology assessment in the early 1950s would have abolished management colleges in developed countries is likely to produce graduates who could not possibly find jobs. Fortunately, the young people did not listen and flocked in record numbers to management colleges so as to get the good jobs which the computer helped to create. It may be stated here that the expert's prediction of computer impact on business strategy, business policy, planning and top management came to nothing. The social and economic impact are almost always the result of the convergence of a substantial number of factors, not all of them technological. The major danger is, however, that the delusion that we can foresee the impacts of new technology will lead us to slight the important task dealt with in the next paragraph.

17. Technology does have impacts and serious ones, beneficial as well as detrimental. These do not require prophecy. They require careful monitoring of the actual impact of a technology once it has become effective. Computer impact was not correctly seen by anybody in 1950. In 1955, howev-er, one could and did see the computer impacts correctly. In 1943, DDT had become a worldwide ecological factor. Work should then have been started on the development of pesticides without the major environmental impact of DDT. The difficult trade-offs should have been faced between food production and environmental damage which neither the unlimited use nor the present complete ban on DDT sufficiently considers. Technology monitoring is not a prophecy. The only thing possible with respect to new technology is specialisation with a bout one chance out of a hundred being right - and a much better chance of doing harm by encouraging the wrong or discouraging the most beneficial new technology. What needs to be watched is "Developing" technology which has

measured and evaluated. Equally important and totally overlooked by the advocates of technology assessment are the impacts of non-technological, that is, social and economic innovations and developments. They are just as hard to predict until they have emerged and can be identified, evaluated and measured. They too, therefore, need being monitored.

18. How should management deal with such impacts as are detrimental to society? If impacts could be eliminated by dropping the activity, this is the best solution. Managerial authority over, and control of, work-community affairs is perhaps the one area where this can be done with direct benefit to the business and management themselves. In most cases the activity cannot be eliminated and there is need for systematic work at minimising the impact while maintaining the underlying activity itself. The ideal approach is to make the elimination of impacts into a profitable business opportunity. This may not be possible in many cases. It is then management's job to work at getting the right regulation enacted by government for solving the problem at the minimum cost and with the greatest benefit to the public and the business alike. And to expect that there will be no regulation is wishful blindness.

19. It is for the social scientists and professional managers to forge the tools necessary for the future managers to handle the problems which they are likely to face in the years ahead. Prof. R.C. Nizam referred to our "attempts to solve tomorrow's problems with yesterday's tools." My only difference with Prof. Nigam is that so far we have not forged any tools. In this connection, we have only refined and modified what experts were doing before the present management boom and made into general practice what whas rare exception.

20. Management will be the crucial factor in the next two decades not only for economic but also sould development especially in view of the explosive growth of population. The rising tide of human expectations, an insatiable appetite for new services and new satisfaction require massive economic efforts. Without a far higher level of productivity it will not be possible to satisfy the demands.

Innovation will have to be the watchword for the future manager who should learn to produce social innovations to make the imported technology work without our culture being affected in any way.

The centre of gravity of the work force is bound to shift from the manual worker to the knowledge worker as time goes on; the economic position of the manual

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worker may not be threatened but his social status and position will diminish. This is likely to lead to a new class cleavage between knowledge worker and manual worker resulting in the weakening of the labour union.

22. The future will be influenced greatly by the way the Manager solves the growing and deepening crisis of the labour union. The future Manager has to think in through the role and function of the labour union.

The two dangers to watch out for in the management of mechanisation are : (a) Making man a part of the machine (b) Misusing the mechanisation as a divisive element in the work group.

The future management will be increasingly expected to anticipate and resolve social problems.

The future management has a tremendous responsibility in identifying and anticipating impacts of new technology the time of its introduction.

MANAGEMENT CONSULTANCY

PART I

(The Preliminary Section).

NCST Panel on Futurology was set up under the chairmanship of Dr.B.D.Tilak,Director,NCL Poona. The Panel has proposed to carry out intensive studies in several areas one of which is Management. To facilitate this study in depth the panel has constituted a Technical Sub-Group on "Management". The first meeting of this Technical Sub-Group was held on the 15th February,1975 at the Technology Bhavan,New Delhi. It was decided at this meeting, that the individual members will send within a period of three weeks to the convenor of this Group, their views in terms of the priority items relevant to build scenerics for the year 2000 in the field of Management.

2. The only management lesson the writer has learnt over a good many years of managing and being managed is that management "Rules must alsways be subordinated to wider human issues. It is only when management behaviour can strike a balance between what is both humanly and technically valid that a relationship between the manager and the managed emerges which is, to put it bluntly, of the least imperfect kind. In Russia are China are are management strategies being applied today which are not in consonance with our own ideas. Are they the more or less "human"? Again there are various shades of meaning to the word" "Technical" management. To assume that a particular management action is necessarily technically right could often be very wide of the mark.

3. Management, its competence, its integrity and its performance will be decisive to our country in the decade ahead At the same time the demands on Management will be rising steadily and steeply.

4. Lack of management puts heavy economic burdens on the economy, which only continuous economic advance can make bearable it demands ability to satisfy our Country's military needs while building up, at the same time, an expanding peacetime economy. It demnds,indeed, as unprecedented ability of the entire economy to shift back and forth between peacetime and defence production, practically at an instant's notice.

5. In the NCST's background paper, Prof.R.C.Nigam, a member of the NCST Panel on Futurology, has dealth with the future issues and problems facing management and public administration. He is of the view that the basic lacunae responsible for the failure of many of our plans is that we have been using orthodix principles of management to resolve unorthodox problems of today. He is keen on mobilising new kind of skills and institutions directed to problem-solving as a primary goal, if we are to meet the challenge of management facing the Futurology Panel today.

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6. As the Scientist in various organisation progresses into positions of greate responsibilities, as increasing amount of his valuable time is spent in writing letters. filling out forms, attending countless conferences, and performing many other administrative functions. These activities are necessary to maintain proper communications in an efficient organisation, but they are wasting the time of many creative people who may not be naturally suited to the routine and schedules that characterise managerial positions. Althought many of them become successful administrators, their original scientific contributions often cease when almost all of their efforts are devoted to guiding the activities of others who may have less ability and creative originality than the person whose time is consumed in administering them. We must rescue the scientists from getting drowned in paper work and taling themselves to a standstill in endless committees. A new professional class of specialists who would serve as administrative assistance to each senior scientist should be created. These administrative assistance would relieve the scientistis of most of the routine work including attendance at the endless conferences and committee meetings. This will ensure a synergistic effect, as older scientists would spend more time with their younger colleagues who may have more of the innovatime tendencies characteristic of youth.

7. It will be important to attract highly capable people into the administrative assistant positions. This can best be done by offering them status and salary comparable to those of the scientist with whom they must closely work. The administrative assistants would advance in parallel progression with the scientists. This career potential would allow the most capable of our non technical people to become part of the ever-expanding main stream of Science and Technology Development The administrators need not have a technical education, but they must be given sufficient training and instruction to be able to understand and work with their scientist-partner.

8. In the socialistic pattern of economy chosen by Parliament and the Government private sector had been allowed to play animportant role in the economic development of our country; but it should be xxxxxxxxxxx remembered that a mixed economy would not yield satisfactory results if a large and important segment of our economic and socialist system is not in alighment with the socio-economic objectives of planning and development in the country. The degree and quality of leadership provided by professional managers whether they be in the public sector or the private sector is of crucial importance to the Planners.

9. Business management could no longer afford to be based on tradition-bound socio-economic structure which had, for a long time, remained unaffected by development in the international scene. Pfofessionalisation of managers is an

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is an important pre-requisite for the efficient and effect management of the Indian economy. This is an area where there could be no conflict but only cooparation among the private sector, the public sector and Government. It woul be advisable to have some mechanism in the NCST to ascerta from time to time to see how for the industrial management were responsive to the socio-economic objectives of the country's economy. To have an idea of the probable growth industry in 2000 - we may forget the study sponsored by the club of Rome and reported in the book"Limits of Growth"- we may remind ourselves that the investment in the public sec in the first year of the First Plan was just Rs.29 crores i five enterprises. Today it is Rs.5,000 crores in over 100 enterprises. This growth represents almost 50% of the total stock of capital in the organised sector of Indian economy. If we take into account an additional investment of Rs.8,000/- crores envisaged in the Fifth Plan, the total investment in the public secotr will be Rs.13,000 crores. The Ministry of Industry should, therefore, be vitally inte rested in the FutuorologyManagement I trust that NCST Pane on Futurology representatives from the Union Ministry of Industry.

10. The multiplior effect of electric power is 100 in a developing country such as cure. One rupee of power supplied generates goods and services worth Rs.100; Conversely a ruppee of power denied has the reverse consequence. The average per capita consumption in the world today is 1000 Kwh(USA leads with 7000 Kwh) while our is unmentionably low 97 Kwh(Punjab claims to have touched 150 Kwh). In 2000 A.D. our requirement will be at least 500 Kwh/Capita. What this means in terms of installed capacity and the financial outlay is mind-boggling. We hav to be adding 4000 MW every year to our installed capacity at a cost of Rs.2000 crores per year to achieve a per capita consumtpion of 1000 Kwh today. Our present record, an addition 400(Four hundred)MW every year since we achiev independence, should given idea of the terrifying nature of the challeange.

11. The complexity of the problems of power managemen can be visualised by turning to the advanced countries whi have to adopt highly sophisticated equipment including computers for the purpose. The load demands continuously very and therefore the generation has to be regulated to match the load. A high sense of anticipation is necessary In the United Kingdom, for instance, it is stated the operator of a power system has to sit with his eyes glued to the TV, not so much absorbed by the performance televis but eagerly waiting for the conclusion of the programme so to be ready to meet the sudden demand on the system when housewives switch on their cooking ranges and electrical gadgets after the programme. Economic generation and

conservation of power are possible only by developing techniques to manage power scientifically. Keeping in view the likely formation of a national power grid at a later date, a major break-through in scientific management of powe systems providing a base for a unified approach and a common training programme for all engineering managers manning the State systems.

12. The power management should take note of certain ineluctable axoims which are still to make the necessary impact on power planners. The first is:Ensure that estimate for power requirements do not turn out in the end to be under-estimates; conversely all estimates of availability n not to be excessively optimisitic -do not turn out proposals too finely with a tooth-comb: No Power generated will ever go waste. The second is: Targets of construction are sure to backslide-this is universal(UK/US included). This means that our proposals must be ready and sanctioned and funds located at least twice as many years earlier asit will take to comp;ete the construction. The third is: If the machines are not maintained methodically they will maintain themselve maddeningly. If anything can go wrong it will. The fourth is: Generation without provision for transmission or with excessive transmission lesses is worse than having no generation- much money is locked up without any adequate outlet. The sixth is: Is there any better system of transmission than the conventional HVAC.

13. The power management should convince the States that if power policy is fragmented within narrow state boundaries it will not be possible for them to have the excellent benefits of the high common economic objectives achieved by the countries in Europe who have surrendered part of their sovereignity in this sphere. Power is continental in reach and scope and has to be dealt with in condidental terms by bringing into being an effective organisational structure mannered by talented administrators and managers. The bette position to formulate the proposals regarding power management after a dialogue with the representatives of the Union Ministry of Irrigation and Power.

14. The factors in labour - management relations that seem most likely to shpae the future appear to be the pressure for an abundance of the material goods; what is commonly called full employment; personal fulfilment of all people; and no hardships on inconveniences due to strikes. In the interest of labour, it is the paramount duty of management to develop new techniques in future to ensure tha productively is raised significantly demands of the work force are lowered to realistic levels and the public's growi intolerance for strikes is stemmed. If the future managers

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do not bring about such a state of affairs the free collective bargaining power of labour will be nothing but a memory by 2000 A.D. There will, then be nothing but chaos. It is the paramount duty of the new manager, to examine the out-of date labour laws and bring pressure to have them revised so that we could be actually modern in the labour-management relations. We live in an industrial relations climate where higher and higher compensation is demanded for fewer and fewer hours of work for more and more people. We all favour this desirable good. But we cannot enjoy there material blessings unless the managers ensure an adequare growth in producitivity.

15. It is very difficult to predict all of the problems that tomorrow's managers will face. But experience leads us to believe that many dimensions of the human equation in successful management may be even more important tomorrow then there are today. The development of appropriate managerial behaviour typically lags behind technical development. It is imperative for the future to find ways to reduce this lag by accelerating human development so that managers can cope successfully with the everyday problem involved in the various phases of human enterprise.

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MANAGEMENT CONSULTANCY

PART II
(The General Section)

Commensurate with industrial growth, there has been a rapid expansion of consultancy services in India. Not so lon ago, there were hardly two on three consultancy firms of any significance; today there are numerous firms and individual consultants in this field which provide services ranging from a feasibility report for manufacture of toys to the designing engineering and commissioning of an oil refinary. Also, not so long ago, it would have been inconceivable that India woul be in the business of exporting industrial technology and know-how; today there are at least a few spheres in which Indian know-how is considered as good as any and a market for export of Indian consultancy services has already been created. A few of our consultants including the writer has been recognised and included in the rosters of consultants maintained by the world bank, UNIDO and ADB.

2. The obsolescence of managerial personnel has become a major topic in our present era of "explosions" of all sorts. This obsolescnece like that of authombiles and appliances springs from the rpaid and dynamic technology that is advancing the fruits of science to the practical ends of the modern society. Borrowing an analogy from the radioactive elements, as the pace of engineering advance quickness, the half life of an engineering Manager today (that is, the perio during which his technical education losses half its value, typically 5 to 6 years)shorters. One can lose his technical education almost as fast as he acquires it, unless he renews and adds to it by continuing education. Professional educationa can never stop. The antidote for obsolescence is goal oriented education.

3. In a background as ours where new technology is rapidly shifting the balance between technical and strategic decision a whole batteny of new tools grouped as "operations Research" (by the way Operations Research is neither"Operations" nor "Research") which are powerful and valuable tools of systematic and ligical analysis and synthesis have come to the rescue of decision makers. Operations Research being scientific by its very character, the whole of its tools need an interdisciplinary team approach by experts in different specialised areas and these experts must share a common interest in pooling their knowledge and resources to attack and discovering better ways of improvement. These in the control of a system could now obtain optimum solutions to the problems involving the operations of the system, though the tools provided by operations research. The spectrum of operations Research is literally broadening every day; it includes problems from inventing control, Machine Replacement Queing and Waiting lines, Game Theory, Allocations, and scheduling to simulation of random models.

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4. There are some signs of uncertainly about the current state and the future shape of consultancy services in India. The growth of consultancy service in India has been haphazard and unevenly distributed-both geographically and functionally. Instances are not lacking where the services rendered in the name name of the profession have not been of the very best and have ranged from the spurious to the misleading. India's progress towards industraliation has created demands for new types of services and in mnay fields what was regarded as "Export* ten years ago has become common- place now. Also the scale of industrial actively has changed-ten years ago, a five crore project was news, today this is the minmum investment required in many industrial activities. Every one knows where to find a consultant on steel or oil refineries. It is, however, idfficult to find out whether a particular service meeting a certain standard is available in the country. The Ministry of Industrial Development, Government of India maintain of r roster of consultants numbering only 23(in 1969-70)including the writer and the Industrial Development Bank of India have their own roster of conusultants numbering 65(in 1972) includling the writer. These lists, to the best of my knowledge, are not known to the public. 88 Consultants for the whole of India - this is most deplorable. A related issue is the inability of many ofthe users of consultancy service to define clearly as to what they expect from consultants. Partly this is a result of lack of experience in using consultancy services since many of the users afe seeking such services for the first time; partly it is the result of inability to define the nature and purpose of assistance being sought from the consultants. Not infrequently, a more engagement of the consultant is considered to be the solution of the problem itself. This inevitably results in dissatisfaction with the services, however conscientious, rendered by the consultant. Therefore in addition to the need for providing information regarding the existance of consultancy services, there is also the question of "educating" potential customers os that they can derive the maximum advantage from the user of this service.

5, It is important to recognise that management consultancy is quite different from Technical Consultancy although this fact is frequently obscured in developing countries where consultancy services purport to offer both. The seminar on consultancy service in India organised by IC&ICI Limited in November 1972 embraced both mangagement and technical consultancy , considerations with little or no attempt to highlight the significant difference between them. This is that whereas Technical Consultancy is concerned with the engineering, design and operation of plant and equipment, Management Consultancy places emphasis on the application of business measurement and quantibid management control techniques such as:-

Methods Time Measurement
Operations Research(OR)

.....3

Programmed Evaluation and Review Techniques (PERT)

Critical Path Method (CPM)

Discounted Cash Flow

Marginal Costing

Zero Defects

Sensitivity Training

Industrial Engineering

Value analysis

Market Analysis and Research

Organisation and Methods etc.

6. There is, of course, a grey area between these two fields of Technical and Managerial activity. Equipment and plant, having been designed, installed and commissioned has been to be managed. Thus, technical consultancy gives way to Management Consultancy, Nevertheless the existence of this grey area should not obsecure the fact that technical consultancy and management consultancy are fundamentally different and are not to be confused.

7. For a long time to come consultancy will be the major source by which organisational changes and introduction of systems and techniques can take place. As an external agent it will be much easier for a consultant to look at the problem objectively and suggest correction without fear or favour. There is a need for strengthening Consultancy organisations and a compaign should be launched to bring enough consultants, and get acceptance for this profession in all the sectors. Various authorities have attributed a Cause - and - effect relationship between the growth of the management consultancy in the developed countries and the economic growth of those countries.

8. An international survey in 1971 recalled that there was one qualified management consultant for every 2250 persons employed in industry and commerce in each of the five developed countries, viz. Austrialia, France, Japan, UK and USA. In certain developing countries this fiture was 230,000 persons employed in industry and commerce per management consultant

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at work - a ratio of around 1 to 100. In India 190,000 persons are employed in industry and commerce per competent consultant at work. This shows the scope for developing the profession in India.

9. The profile of management consultancy in India is of a few large organisations working at an adequate professional level and a larger number of small organisations, only some of which are professionally acceptable. The large Consultancy institutions tend to work mostly in the public sector. There is inadequate provision of consultancy assistance to the medium and small organisation in the private sector. The emphasis of the work undertaken is towards personnel, employment and marketing matters and away from the application of the direct quantitative productivity raising techniques largely developed by consultants in the developed countries. Most of the work consists of advice-giving rather than the implementation of recommendations of the consultants. There is an acute awareness among those best placed to know about the possibility of, and the need for, upgrading the management consultancy capability of practioners in our country. Their potential ability to raise productivity with virtually no capital investment is fully appreciated.

10. The specific body of knowledge required by a Management consultant has been summorised by the appropriate professional bodies under the following headings:-

1. Relations between functional activities and the elements of managing.
2. Production
3. Marketing
4. Personnel
5. Finance and Control
6. Secretarial and Legal
7. External Relations.

11. The acquisition of the above common body of knowledge by consultant takes place partly prior to

entering the profession and partly by study and practical experience. Practice of six to ten years is essential to become qualified at the high levels of the profession. The areas where management consultants could help are:-

Administration and Managerial

Reorganisation of Management structure, Management Training Courses for staff Personnel Management

Accounting and Office

Office Layout

Office procedures and equipment

Budgetary Control and Management accounting

Costing systems

Marketing

Research

Sales organisation

Production and Stores

Factory Layouts

Stores and Warehouse layouts

Production Control

Stock Control

Training of Supervisors and operators.

Material handling and transport

Improvements in methods of working

Labour cost Control

Quality Control.

12. In part III Consultancy Development in India is dealt with.

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MANAGEMENT CONSULTANCY

PART III

(The Special Section)

(CONSULTANCY DEVELOPMENT)

1. a) The capability of a large number of existing Consultants needs upgrading in terms of both approach and practice/Expansion of the total number of Competent Consultants is required.

   b) The image of consultancy in the public eye is to be improved.

   c) Clients and potential clients need educating in the ways of consultants and how they can best be used.

   d) A national code of ethics and practice for management consultancy needs promulgating by statutory instrument.

   e) Professional Association of cohsultants should be formed analogues to the institution of Engineers (Indian). Chartered Accountants Institutes etc. This will eliminate the charlatans in the consultancy field.

2. To achieve the above objectives it is envisaged that the consultants themselves need consultancy assistance from a team of expert consultants. Staff colleges and higher Management institutions in India should be able to provide the nucleus for this team. Such a team should operate from an apex focal point within the Government/not attached to any particular cohsultancy organisation. The services of this team should be available as required to any ministry or consultancy organisation in the public or private sector. This team may be designated as "Management Consultancy Development Team". NCST may consider preparing a comprehensive project document to spell out the inputs that would be required to field a management consultancy ddvelopment team and define its method of operation, timetable and goals.

3. Much of the Consultancy work in India is of a part-time advice-giving nature. Indian consultants

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have the concept of part-time work being normal for their business. This stands in contrast to the western concept of a consultancy assignment as a full time activity which moves from a preliminary survey, through analysis and recommendations to implementation and completion. The future expansion of consultancy in India is assure if one can judge from the experience of the truly competent firms such as Tatas and Dastur that are large enough to do a complete job. Without exception such firms of consultants have full order books well into the future. This indicates that client acceptance is increasing when they confine a fully professional ethical consultancy firm. The services available from USA, Canada, UK, Europe etc. do not suit India's needs. Apart from the excessive cost, there is the question of knowing the business climate and political situation in India. While it may be possible to import technology, it is not advisable to import management consultancy. We have sufficient expertise in India which requires only upgrading and solid support from Government.

4. Before concluding I would like to refer again to "Ooperations Research" which is a very recent acience. It is not possible to state anything authoritatively regarding its future scope in life and industry. However, the rapid and spectacular development and progress of the subject definitely indicates its tremendous potentialities the promoting and sustaining industrial as well as economic growth and stability. Aversion of most industrialists to this science, is probably, due to a great extent to the mathematical treatment of its various techniques. Learning apart a few of the mathematical models and techniques most of the field in Operations Research could be covered by only an elementary knowledge of algebra. A cooperation approach of the academicion and the man from industry will definitely exploit this science in the post-industrial period for the good of the mankind and lead to social and industrial prosperity.

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PLANNING FOR NATURAL RESOURCE DEVELOPMENT: ENVIRONMENTAL MANAGEMENT POINT OF VIEW

by

Dr.A. Khosla*

Planning for natural resource development must give full attention to the various environmental factors. These include all the human, social, physical and ecological considerations. The process of management, including the setting of goals and the planning, implementation and operation of specific projects designed to achieve these goals, and the detection and solution of emergent problems, should therefore incorporate environmental considerations at all stages. Only by internalizing the environmental dimension into the decision-making process will it be possible to minimize the undesirable side effects which are responsible for most environmental problems. Many social decisions are made on the basis of an inadequate consideration of the full set of goals, and this can lead to outcomes which are less than fully efficient. By a process of creative generation and consideration of a wider set of policy options, embodying particularly the environmentally relevant values, actions can be taken which contribute to improvement of the human condition in its widest sense.

Environmental management is the integrative ecological, cultural, economic and social process by which the human environment is developed in a holistic and systematic manner through the optimal use of existing and potential resources of the biosphere, for the ultimate improvement of human well-being. It aims at the maintenance of the long-term sustained yield from the biosphere, and should be designed to provide greater personal and social opportunities for present and future generations.

There are several broad areas and, within these, a number of hierarchical levels at which management decisions are made. The effects of these decisions on the environment - at any level - can be quite significant. At functional levels of management, the broad policies formulated by a

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The author is Member of the NCST Panel on Futurology.

There are several broad areas and, within these, a number of hierarchical levels at which management decisions are made. The effects of these decisions on the environment at any level- can be quite significant. At functional levels of management, the broad policies formulated by a Government, the programmes worked out to achieve these policies, and the projects chosen within the programmes, al have major environmental ramifications and implications. So does the manner in whic the susbequent operations are conducted. Similarly, groupings (such as individuals, municipal, provinical, national, and transnational regions), and administrative frameworks(such as departmental jurisdictions and burecratic responsibilities) will often determine the kinds of action possible in a particul situation. Hierarichical considerations are also involved when considering technologies(e.g. transportation,transportation communication), etc.)communities and social systems.

Planning tools(Tools which are needed in the formulation of rational strategies for economic and social development).

Information systems
Analytical methods
Organizational links
Procedures for public participation in the planning process
Valuation machinery

Implementation instruments(Tools which are applied by institutions to induce behaviour by the activities involved such as mines, farms, households, industrial plants).

Direct

Prescription or proscription of behvaiour:
housing codes, product and raw material specifications, effluent standards, permits, direct investment

Indirect

Tax policies
Zoning
Effluent chages
Subsidies
Pricing policies for factor inputs, i.e. energy faw materials
Education

Direct instruments are prescrptive or prohibitive, aiming at pa icular action(or non-action) with respect to economic activitie with a manifest environmental impact. Indirect by such means as geneal appeals, eudcation persuation, new social norms, or such fiscal measures as effluent charges, subsidies, taxes etc.

Any choice of technology (a term which is meant to include pattern of resource utilisation)implies certain consequences, predictable or unpredictable, direct or indirect good or bad. In the development of any technology, therefore, whether at the stage of research, innovation, development or design, a detailed assessment should be undertaken to evaluate the possible consequences. Such an exercise, often known as Technology Assessment or Environmental Impact Assessment has rarely been done in the past but is sure to become an integral part of future decisions concerning technical development.

The concept of alternative technologies should include the following:-

1. The Economic Implications of Alternative Technologies:

A consideration of the short-term and long-term economic effects of the wisespread adoption of alternative technologies, particularly as to their impact on overall growth rates, income distribution and other factors such as dependency and international trade.

2. The Social and Behavioural Implications of Alternative Technologies:

The consequences of technological choice on life style, strcture of settlements, and the relationships of man with man, man with nature and man with machines.

3. Development of Methodologies for Evaluation and Choice of Alternative Technology Options

Techniques for assessing the impact of a technology on the environmental, economic, demoraphic, sociological and other variables. Criteria to assist in the optimal choice of technology.

4. Development of a systems Approach to the Problem of Technology Utilisation:

Possible methods for systematically minimising consumption through reduction of unnecessary waste of materials and energy, whether manifest or hidden. Systems analytic methodoloiges could be identified for evaluating the magnitudes of savings possible, as well as for their use in various energy generation, transporation, industrial, domestic and service sector applications.(In view of the inter-relatedness of the various factors and in order to avoid the problem of sub-optimization, it may be necessary in many cases to take an integrated view of a whole package of complementary and competing activities covered in sections 6 & 7).

5. Selected Technologies in Specific Sectors

Taking broad sectors such as Agriculture, Industry, Energy Shelter, Transporation, Health and Sanitation and Education, a survey should be made of the alternative technologies needed and available. In agriculture for instance, consideration should be given to water resources, fertilise soil management, pest control, implements and infra-structu In the fields of industry and non-renewable resources could be explored.

6. Methodology for Development & Implementation of Alternative Technologies.

The respective roles of scientists and scientific institutions, government and public sector organisations, international agencies and entrepreneurs. To assist in solving the common problem of lack of implementation and resistance to widespread adoption of certain alternative technologies, it would be useful to present, analyse and develop the types of structures and relationships of institutions set up to promote work in this field and to work out the kinds of backward and forward linkages needed.

MANAGEMENT EDUCATION AND TRAINING- A Discussion Note

by

Capt. S.S.Rao*

Any consideration of the future of management education and training in the country has to be based on a vlid estimate of the training needs, both qualitative and quantitative. Of the two, the quantitative estimate would be the simpler to arrive at based on the projections of the growth of the industrial and service sectors of the economy. These are available from some studies already carried out, like the Second India Series of Studies sponsored by the Ford Foundation. The studies to be undertaken by relevant sub-committees of the NCST Panel on Futurology would also provide some needed data. However, it must be stated too that even the quantitative estimate of management education needs assumes complexity linked as it is inseparably with the qualitative considerations discussed in the subsequent paragraphs.

2. Problems arise in qualitative assessment of the management education and training needs.

3. The major hurdle is the definition of the oncept of the needs for management education. To my view, the major reason is the absence of sound theoretical consideration of the why and what of management i.e. an analysis of the phenonmenan of management and its content. No two organisations seem to agree on professions or positions in their organisational system or hierarchy requiring managerial capacities. The few research studies on assessement of needs for management education that I have come across seem to be more concerned with the methodological issues rather than with such an analysis.

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*Capt. Rao is member of the NCST Panel on Futurology's Technical Sub-Group on 'MANAGEMENT'.

4. The need for reflection on the part of this sub.committee on this basic issue is thus the first essential.

5. Another task would be to evaluate the present pattern of delivery of management education and training. Do our institutes of Managements produce Managers? Or should they? If, on the other hand, problems in the market place and in organisations create managers, is there a contribution that the Institutes can make to help improve the process?

6. Questions too need to be asked about the relevance of the broad-spectrum 'General Education' approach of the 2-year post-graduate programme of the Institutes when business organisations look for specific functional/professional specializations when planning their intake.

7. Coming to the Executive training/development programmes in the country, the scene is good deal confused and also confusing. A variety of agencies have been active in this field. Their programmes have been subscribed to by organisation for beweildering variety of reasons too. Executives have been nominated for these programmes for reason of punishment, reward, vacation, status, compensation etc.

8. Briefly, therefore, the experience of nearly two decade of management education and training in the country has not be so reassuring that a group like this sub-committee can confine itself to a mere quantitative assessment of training loads and resources required for them in any projective study of the future. A cursory examination of the qualitative elements is apt to raise fundamental questions about the relevance hithert of the form and content of what has passed for management education. If a radical change or break-away is warranted, it has to be identified in all its dimensions and its anticipated direction charted for future planning.

SERVICE SECTOR MANAGEMENT

by

Dr. S. Maudgal*

I. Public Service Institutions are the real growth sector of a modern society. It is a common belief now that they are to be run not with a framework of public-service bureaucracy. There is need for increased management consciousness as can be introduced through now familiar management development programmes like Management BY Objectives (MBO). The important thing is that they should be managed for performance. Managing the service institutions for performance will increasingly be seen as the central managerial challenge of a developed society, and as it's greatest managerial need. The service institution does not differ much from a business enterprise in any area other than its specific objectives. When they do not perform well it is because of the following three reasons:-

.......their managers are not business like;
.....,,they need better men;
.......their objectives and results are intangible.

With slight modifications this will apply to all service sector institutions. In India service institutions have an additional challenge in view of the fact that their role is altering steadily. As an example we can see what is happening in the field of banking.

II. An illustrative case (Banking).

Traditional role of banking has been two-fold:-

1. Safekeeping of public savings, and
2. To supply credit.

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* The author is working with N.C.S.T.

In playing this role, main emphasis was on "Profit Maximisation". To this end the operations were geared to:

1. Capturing as many accounts as possible, and

2. Investing the available funds only in safe ventures.

Present Needs of the society, however, are that credit facilities (mainly short-term) should be made available to entrepreneurs - small and medium sized - farmers, low-income groups, etc.; with a special emphasis on financing projects oriented towards -

(a) Employment generation; and/or
(b) Increase in productivity.

Social benefits rather than profit maximizati to the bank is, thus, the new guiding principle.

The changed goals require an entirely differ approach to banking management both in urban as well as rural areas.

The policy evolved should:

....Establish flexible feasibility criteria for projects to qualify for financial assistance;

.....Relax the security requirements;

....Streamline the whole loaning process;

.....Establish outlets in remote villages also so as to make credit facilities accessible to poor and illiterate villagers.

The task is a peculiar combination of Mass Education and Financial investment. (A beginning perhaps, has been made in this direction but much more requires to be done).

To meet the challenge, the Management itsel would have to undergo a change in attitudes and thinking.

An entirely new management ethos is, therefore, required.

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The requirement that the manager should have not only techno-economic expertise but also a keen understanding of human nature and almost an evanglical fervor to help the farmers and entrepreneurs identify, formulate, finance and implement the development and employment oriented projects demands a totally new breed of banking managers who are educated and trained to meet the changing responsibilities.

1. Social orientation.

2. Performance criterias to influence decision making as against Procedure Orientation.

3. Organizational structures to alter with reference to new functions and obligations.

4. Development of Management Information System (MIS).

5. New need-based Training Programmes to Develop Manager based on client-need, market conditions or behavioural science input.

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Future Management Vistas

by

Mr.A.D. Moddie

The management vistas of the future in India may be visualised in broad perspectives to provide grist for a preliminary discussion.

1. There will be the basic and critical importance of new management efforts towards three fundamental areas, very largely neglected so far. They are water management, energy management, and population control management. The very basic nature of these problems requires no discussion, but the development of management approaches to deal with them call for much thought and long-range planning. Whilst India's opulation doubles, energy and water availability fail to match development needs. Without adequate energy and water, no developmental progress is conceivable. These are fields for the best management inputs of the nation; hitherto they have been the most neglected in high quality management terms.

2. Next only after water and energy systems management comes the importance of resource mangement in all aspects of rural and urban planning. These will require the exploration of new mangement possibilities in the extension of banking to rural areas, and the application of better financial management practices over vast new areas of the economy. The era of reasonable resources is over. The era of scare resources will demand stricter disciplines of financial management in planning and implementation for better returns from investments, and for the more self-reliant generation of internal resources as sources of external resources dwindle in real terms.

3. As the development of Indian agriculture is the next fundamental of development, the industrialisation of agri-business along modern lines will call for new mangement approaches from the productivity of farm and forest produce to processing technology and marketing.

4. The doubling of India's population to a billion by 2000 A.D., with a possible trebling

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of urban urban part of it, will call for major new vistas for urban and rural planning. This will be one of the major fields of real integrated planning between demographers, architect planners, ecologists, and technologists to humanise human settlements, avoid slum and squalor, and improve the quality of life.

5. The possible trebling of the urban and industrial work force will lead to major problems of social stability, and this leads to a fifth major vista, namely, the mangement of highly politicised industrial relations matters. Without sound conflict mangement here, the social stability of the entire urban structure of the country will be in jeopardy.

6. The internationalisation of Indian industry will be a significant new departure from the inward-looking era of the past. This internationalisation will manifest itself in many ways in many types of exchanges of technology and capital; partly to keep abreast of the world, partly to promote growth, and partly to promote the international trade sector. This has already begun with bi-lateral commissions and trade pacts, with a combination of petro-dollars and Indian know-how; and it may extend to vast areas of new collaborations not only with the developed countries, but the developing ones; apart from the USSR and East Europe. All these possibilities call for prior study of understand the implications of the complexities of the first major phase of the internationalisation of Indian industry. The closed national economy will give way to the concept of the "global village" and of "spaceship Earth".

7. India offers tremendous scope for the mangement of a modern tourist industry, which also respects local landscapes and cultures; more so as tourism is the world's fastest growing industry with promising potential for foreign exchange earnings, employment and income generation. The mangement complex here embraces air-lines, shipping, hotels and travel agencies.

8. The modernisation of the small and medium sectors has begun and will be inevitable for their survival and growth. Public policy and business managements have to discover ways of bringing about these rapidly and complimentarily

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with the large scale sector. Past ideas of small-scale growth in isolation may need to change if modernisation and complimentariness are compulsions.

9. The next major vista will be the need for the management of, at least, two major social services. They will be the much extended educational and hospital services of the country. The importance of these for social stability and social health will be tremendous. So far, there has been no mangement-orientation in these areas.

10. The development of huge transport systems with enormous financial outlays and physical assets will call for another area of integrated management systems. They will include road, air, rail, and inland water transport. The problems of coordination, competition, traffic forecasting, and techno-economic options in the transportation of goods and people will call for management study for both policy options and for implementation.

11. A major social objective of the next decade will be the Minimum Needs programme with an extensive public distribution system for lower income groups. This itself willbe a stupendous manggement task involving production, price and distribution implications of vast dimensions; perhaps the world's largest and most singular operation of its kind. It has been five years already in gestation, and may take many more to implement.

12. With defence expenditure amounting to 22% of the central government's budget, with mounting and sophisticated defence production industries, the dimensions of the economic and technological mangement there are enormous; especially with materials management and value analysis needing to play major roles in techno-economic decision-making; in he context of the gargantuan defence budgets of the next twenty-five years.

13. A very important necessity of the future, after the investments and the experience of the poast two decades, will be the bridging of R.D and operating managements in all sectors of agriculture and industry. This will be a challenging field for innovation and experimentation in new forms of organisational approaches to the problem of harnessing science to appropriate technology at the least cost.

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14. The complexity of all these problems, and the growth of management development needs, will inevitably lead to an explosion of management education, which will need to be guided and designed with perhaps three major objectives in view:-

a) Firstly, the laying down of priorities in relevant fields;

b) Secondly, the closing of the many knowledge and data gaps with which the economy is riddled, and which come in the way of sound and informed decision-making and

c) Thirdly, new methods of tackling the inter-disciplinary nature of the complex socio-economic and organisation problems of the future, together with new disciplines like Ecology and Environmental Dynamics.

All these are appalling tasks for national and unit managements of the future; tasks of continental dimensions in scale and complexity; unmatched in any country save China. The basic pre-condition for the success of economic and technical management will be a mature political management of Indian society; to contain conflicts within bounds, to encourage and reward success, and to make accountability real. Without these, the conditions of Myrdal's "soft state" will lead only to tragic drama; and one of the world's finest management potential would not have had its fair chance in the critical generation ahead.

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EDUCATION

Education Pattern for Future: A Poser

By Dr.S.C.Seth*

1. An educational system for the future needs to have new objectives of education. The present educational system does not produce man-power which society can readily absorb. Nor does it help turn existing population into active manpower as a national resource. We should make education as the instrument of turning India's population into a resource.

2. Today, our emphasis is on formal training, learning by rote and production of theoretical papers. This educational system is unrelated to life and society. Even scientists only work to see their names in Western journals. Thus our educational structure, in terms of syllabus-programme content, evaluation and graduating yardsticks, also deserves to be altered. We should have instead a programme content which includes part study-part work(Chinese have tried it with success).

3. The evaluation or the graduation yardstick should not merely judge the memorising skill but due recognition should be given to those who contribute to the production process in the country; be it at the cottage industry or be it in the field of sophisticated industries. Teaching techniques should be changed.

4. The optimal use of the existing set-up inter alia poses the question if the higher education should be frozen for the next five years? There should be no expansion in the existing infra-structure in this field is another debatable matter.

5. A cost benefit analysis should be made as to how much it costs the nation to make a graduate of different types medical, engineering, general and so on and what the nation in turn benefits from them.

6. Value system, life styles and educational pattern: There is need to re-evaluate the existing norms and value systems which have given birth to false life styles unsuitable to a country where, less than half

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* Convenor, Technical Sub-group on 'Education'.

of our population lives in urban areas and the majority lives in the rural area. If it is true that our educational system upholds the urban life-style and caters preponderantly to the needs of urban elite alone, should it not be altered? In fact we need to act in reverse. We should develop an educational system so that work in rural areas may become more attractive. Education should be able to solve the problems of India - mass unemployment and mass migration of rural population to the cities.

7. Finally, it is suggested that there should be a total bar on school buildings and expansion thereof. We should instead make optimal use of the existing buildings. We can educate young people upto 11.P.M. in the night by shift system. The class-room technique is expensive. We should combine it with satellite communication educational programmes. Given ideal combination of hardware(satellite) and the soft-ware(educational films, etc.) in the long run would be less expensive a way of coping with the demand of educating an expanding populati (580 million today - 960 million in 2000 A.D.).

8. We also need to tag all units of production with one educational institution or the other e.g. Cottage industry with functional literacy centres - industry with technological institutions.

9. The educational goals of Future oriented educational system should have a great deal in common with the National developmental goals. Today, there is contradict between the educational goals and the developmental goals

10. The technical sub-group may kindly comment upon the points posed above and formulate specific issues that deserve intensive study.

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SOME GENERAL COMMENTS ON THE DOCUMENT ON EDUCATION PATTERN FOR FUTURE : A POSER

1. From Rev. T.A. Mathias, S.J., Hony. Genl. Secy.
All India Association for Christian Higher
Education, 4, Raj Niwas Marg, Delhi-110006.

Point 1: Worded as it is, it is impossible to disagree with this point. I would like, however, to specify that the objectives which education should have in view must be the same as the national objectives, viz:

1. Consolidation of democracy.
2. Strengthening of secularism.
3. Establishing of a just society.
4. Promoting national integration.
5. Fostering economic growth.
6. Modernisation of society and yet strengthening of moral and spiritual values.

Point 2: There can be no doubt that the present educational system is to be radically transformed in its methods, its curricula and its modes of assessment. If the present bias towards memory work is not removed, our education will be more of a handicap to the nation than a help.

Integrating education and work in such a way that those receiving education put in work and all who are working continue their education, is certainly an ideal to be aimed at. But without pressure and regimentation in society (as in China), it is going to be extremely difficult to implement.

Point 3: I fail to see how a "Contribution to the Production Process" in the country can be made a yard-stick for evaluating the education received by a young person. However, there is no doubt whatever that the present memorising type of examination is worse than useless.

Point 4:- I fully agree that opening of fresh colleges and universities for the "traditional" type of higher education is to be halted, at least for a period of five years. An exception can, however, be made for remote and backward areas of the country, viz: the North-Eastern region where a few colleges may be needed. However, even here care should be taken to ensure that the colleges are of a different type.

Point 5: I believe this cost-benefit analysis is of great importance chiefly in regard to the professional courses on which the country spends so much money and from which the best graduates are drained away to affluent countries. Such an analysis will also help to plan the type of education the country needs and must by all means provide even with its limited funds.

Point 6: There is no doubt that the present system of education is oriented towards the tastes and the needs of the urban part of our population and almost completely ignores the rural people. The so-called "campus culture" we find in many institutions is often alien to India's own culture and divorced from the economic and social realities of life in this country.

How to change all this, however, in a free society, is another and most anguishing problem.

Point 7: I fully agree that the present school buildings should be better used by having two or three shifts in them.. While I do not agree with a total ban on new school buildings, I am convinced that the type of school buildings should be considerably simplified.

We must realise that it is virtually impossible to educate the Indian population in the traditional way, i.e. in "schools" i.e. in buildings and with teachers of the ordinary kind. New informal methods of education like SITE have to be found.

Point 8: This is an excellent idea and I believe can be worked out.

Point 9: I fully agree (cf. my remarks under point 1).

Point 10: Issues that deserve intensive study:

1. Integrating education and work.
2. Financing Higher Education.
3. The present grant-in-aid system.
4. Freezing higher education quantitatively.
5. Transforming campus culture.
6. Informal educational methods.

2. Dr. (Mrs.) Kunthala Jayaraman, Madurai University
Deptt. of Biological Sciences, Madurai-625021.

The best course for the future planning is not to undo what has been done in the field of education during the last 25 years after independence, but to aid it to diversify it. Talking of elevation of standards of education is one thing but to decry the very fundamental pattern is not very wise. We do not have sufficient momentum in basic scientific thinking and how can one arrive at the conclusion "Too much of it"! A broad based basic education is an essential requirement for producing literate and intelligent citizens. What must be done in addition to this is to organise need based academic programmes with a lean on indigenous requirements. Thus, there must be talk about the diversification of the under-graduate and graduate programmes.

In rural areas naturally the formal training is of little value and also the schooling pattern must take into account the seasonal requirements of man-power for agriculture and industry prevalent in an area. To quote a specific example, during the harvest seasons, the village schools are bereft of students since they are employed in the fields. If the periods of school education could be adjusted to meet the local needs, the response of the community to the school education is bound to be high.

Besides formal education, agricultural crafts must also be taught for their gainful employment.

At the higher level, applied courses are already practising the custom of deputing the students to the industrial units for a training. This programme may be enlarged and the industrial units sponsored by the Government must make it a compulsory feature to train some graduate students.

These points need to be taken up quite carefully and extensively and the help of the agencies such as NCERT, UGC must be sought before finalisation of the plans could be made. These agencies mentioned have spent considerable time in modernising the curricular patterns and their advice will be invaluable for formulation of a national policy. The need for a uniform pattern of education throughout the country, at least in the number of years spent in school should be emphasized herein.

4 This step suggested is a step in retrogation. Instead careful assessment of the potentialities of the institutions offering post-graduate courses must be made and the number of students in their course should be on part with the faculty strength and other facilities.

5. As a part of the professional training imparted to the graduates, their service in a sort of a national core service must be emphasized wherein the professional graduates turn in at least 2 years of their work period, in rural areas and applied institutions. Preferably, a migrating pattern must be envisaged so that there is an opportunity for national integration. This core service programme would prevent the immediate migration of the talented technicians and scientists, outside the country. This also gives an opportunity for them to look around their own country and feel the need for their service.

FUTURISTIC APPLIED TRENDS IN BIOLOGY (BIO-ENGINEERING)

Enzyme Technology

The catalytical role of enzymes in carrying our reactions in living systems which are almost impossible under lab conditions, is well understood. In recent years the proteins involved in this reaction have been extensively purified and their characteristics are well known. A more interesting development of this field known. A more interesting development of this field has been the coupling of the enzymes to an insoluble matrix, which enables these enzymes to be re-utilised several times over in the reactions.

This has resulted in an enormous cost saving for the research laboratories and also is being slowly absorbed by the industries. Since these catalysts do not themselves take part in the reaction, they could be constantly roused within limits of stability. Some of the important reactions wherein they have industrial applications are:

a) Sugar production from cellulose (with immobilized amylase).

b) Production of drugs (synthetic penicillins using the enzyme penicillin amy lae).

c) Production of various organic compounds such as alkalloids, etc.

This is an area, where interaction of chemists, biochemists and engineers is very vital and the potentiality of this system for the future needs of our country should be assessed.

It may be mentioned here that this area has been identified as one of the areas where funding has been recommended by the National Science Foundation, USA as they have realised the importance of the need for procuring information in this area. Several industrial firms in the West are also showing considerable interest in this area. Information could be gathered in India from the National Laboratories involved in the applied work such as Hindustan Antibiotic Rishikesh, Pimperi: National Chemical Laboratory, Poona: Central Drug Research Institute, Lucknow: and Indian Institute of Science, Bangalore.

CONVERSION OF EXISTING PROGRAMMES TO JOB ORIENTATION IN BIOLOGY.

The need felt for the trained medical technicians is an acute one.

One of the ways in which this problem could be somewhat evated would be by giving short-term courses for the B.Sc. graduates in Chemistry/Biology/Microbiology/ Biochemistry in the following area.

1. Clinical Technician Course in Biochemistry
2. Clinical RTechnician Course in Pathology
3. Technician Course in Applied Microbiology.

These courses could be run either by the competent departments in the Universities or by the industrial establishment set up by the Government of Indiap

It is known that several nationalised banks have a scheme of Employment Orientation and are willing to advance funding for the training graduates. In several rural areas in India, there is a dearth of these technicians specially in the field of medicine and health. After they are trained in this area ti is possible for them them to set up a laboratory with the help of these banks and it should not be too difficult for us to train in the next five years a few thousands of these technicians. Thus the graduates may be oriented for gainful employment.

3. Dr. (Mrs) Madhuri R. Shah, Vice-Chancellor,
Shreemati Nathibai Damodar Thackersey
Women's University, Bombay-400020.

In the educational pattern for the future, we will have necessarily to think of alternatives in education which would cater to the needs of different groups, be the Urban or Rural as well as different cultures. The assessment of the present educational systems and its objectives will help us to pinpoint the weaknesses in the present system and the new objectives and priorities which would need to define so that education may become an instrument for change as well as for productivity.

2. Both daring and brave step will have to be taken if we want to reemphasise formal change and efforts will have to be made to take the risk of revolutionary changes in the examination and assessment patterns. International assessment, evaluation of programmes which are part study and part work will have to be introduced and strengthened.

3. Inter-relative and co-ordinating teaching techniques with the world at work is absolutely essential. There may be also a place for academic excellence for others interested and with such aptitude. Equally important is the provision of facilities for the non-academic youth to enable him to be a resource and a productive part of the population.

4. I think we will have to think of alternatives instead freezing higher educational expansion. We can improve the present programmes and at the same time develop new avenues for higher educational facilities which are need-based.

5. I think we have already got cost benefit analysis worked out for the different professional courses of studies. But it is very difficult to assess the intangible gains of education. However, an effort may be made.

6. There is a need to evaluate the value systems and existing norms and study the changes required to meet the rapidly changing needs of the society.

One of the important problems which will have to be kept in view will be the question of educated unemployed.

7. Maximum utilization of school buildings is a must. But non-formal education needs to get greatest response together with programmes of formal education so as to achieve the maximum benefit.

8. There cannot be two opinions about the educational goals being related to national developmental goals. How this could be achieved will require careful thinking and planning. I also feel that in view of the decision to extend compulsory primary education for 7 years to all children, it is absolutely necessary to find ways and means to reduce the wastage arising out of stagnation and drop-outs in schools in addition to developing programmes for the first 7 years of learning which may be useful and may be need-based for the children.

4. Prof. Y. Saran, Principal, Technical Teachers' Training Institute, Bhopal-462002.

I am afraid that the objectives of our educational system have yet to be precisely defined in the common understandable language which could be grasped by the students, parents and the teachers. The relationship of our education to national problems, State problems and community problems is totally missing at the moment. Educational system at all levels has to be geared to it or rather influenced by it. The only way of turning India's population into a resource is through a well defined series of fresh objectives and the entire planning for education to be directed towards the fulfilment of those objectives.

The educational system today is too rigid and lacks association to the environment in a community. We should prepare a frame work for considerable innovations which should permit flexibility in the modes of attendance by the students and strong encouragement of scheme designed on a unit basis with the opportunities of flexibility, transforability and maximum credit for previous study which a student offered. This flexibility alongwith an emphasis on the role of educational institution to serve the community needs may shift the emphasis from formal training and take it towards experiences related to life and society.

There is no difference of opinion in the country at the moment on changing the evaluation system or changing the graduation yardstick. Yet, the indicatio of change are very slow, though positive. Well defined objectives would lead to a meaningful evaluation in any course as they have a direct bearing on one another. Teaching techniques would automatically change in our examination oriented system, once the evaluation techniques are changed. The importance of changing the tea ing techniques cannot be over emphasised. Teaching strategies are many and could be usefully selected or evolved on the basis of learning outcomes desired. These learning outcomes depend upon the teacher competence, resources and the behavioural objectives that are to be attained. Change in teaching techniques would require a mass scale teacher training programme through a series of short courses as otherwise the process would be too slow and may require a century to cover all the teachers. Some major innovations at TTTI Bhopal in this direction are worth taking note of.

"If the higher education should be frozen" or "there should be no expansion in the exsting infra-stru ture in this field" are statements which postpone the problem which is becoming more and more serious with th passage of time. I feel that the emphasis should be o evolving suitable policies and a long range perspectiv for the higher education system on a scientific basis without any reservations and predetermined notions. 'Systems thinking' should form the basis for the formulation of such policies. If properly applied, systems approach would lead to optimum use of the existing set up and would lead to a higher education system to a mo meaningful role in the country's development.

The cost benefit analysis is a tidious, difficul and expensive process. If not done properly it may lea to erroneous conclusions. I would suggest intensification of educational management and administration techn ques to cover the principals, heads of departments and professors, the directors and other senior officials responsible for policy formulation and its implementati Major emphasis in these programmes in the initial stag should be on judging the effectiveness and efficiency an institution, resources planning and utilisation, institution and community, management by objectives, faculty development, group working and the role of students. When our criteria on these and a variety of other aspects are well established, the expensive exercise of cost benefit analysis would lead us to proper results.

Emphasis on well defined goals and educational objec~~ti~~tive and relating educaion to community would shift the emphasis automatically from the urban life style to the needs of the frual system and its development.

Technology is influencing the resources and their utilisation in educational institutions. Fresher norms developed in many countries for resources have resulted in savings in the school floor areas to the extent of 50% sometimes. It is necessary that the impact of technology in our education be progressively expanded and the norms of resources suitably revised. Staggering of school timings, revised norms and the use of education technology would enable us to meet the demands of educating an expanding population.

To tag all units of producation with one educational institution or other might not provide us the best answers, where creativity, innovations and research are desired. Such tagging would make the education routine and unchallenging. Where skill is desired or techniques are to be taught or even problem solving competencies are needed, this tagging would pay rich dividends. For better education leading to research, development and creativity, simulations are necessary and the students must develop a vision which one industrial unit may not provide.

This is absolutely necessary and the educational objectives in the country should have a direct relationship to the developmental plans. Science and technological education should be supported by such developmental efforts and it would not be out of place to mention that a percentage of the budget of developmental plans should be earmarked for the related fields of education and their proper development.

5. Dr. Malcolm S. Adiseshiah, Vice-Chancellor, Madras University, Madras.

There are here two separate but related issues. First the future Indian society, its nature and objectives. Second the future Indian Educational System, its nature and objectives. We must first begin by defining or have defined for us (by someother sub-group) the nature and objectives of the future/Indian society. I would define it as one of peace, sufficiency (not plenty), equal sharing of poverty, and international understanding. In light of this, I would define the objectives of education as the development of individual personality in those directions and the capacity for life long learning.

2. The future educational society should be a learning society, where every occasion and occupation - the home, the temple, the club, the office, the farm, the factory, radio, TV and film, etc., as well as the school and college - will provide learning experiences. The school and college will then lose their false monopoly as learning loci and will become only one of the learning media.

3. The learning achievements of individuals in the future - not simply learning opportunities - should be equalised: this has implications for learnin methods, teaching technologies, and evaluation systems

4. Higher education will involve two learning systems - vocational, technical and agricultural - for large numbers of intermediate level personnel on the one hand, and centres of excellence in the natural engineering, social, human, agricultural and medical sciences for the managerial personnel, on the other.

5. Systems of cost effectiveness rather than of cost benefit are practible and effective in the cas of gross domestic (Human) capital formation.

6. Education if properly interpreted to inclu all learning media, occasions and systems - and not th formal school and college systems only - can contribut to the society of peace, sufficiency, sharing and understanding of the future. But this also requires a prior change of our present unjust, inequalitarian and false value - loaded society. No learning system can perse solve the malaise of a society - whether it be mass unemployment, power concentration or rural migration.

7 + 8 + 9. All infrastructures - the school, college, laboratory, workshop, sports fields, factory, hospital, etc., - should be fully used - 24 hours - as learning locales. There is no sanctity in everyone sleeping when the sun goes down. Sleep and rest like work and toil can be staggered so that all 24 hours ar

used. There will be Learning to be, Learning to do, Learning to fight for a just society.

The future society and the future educational systems starts with the need for a complete restructuration of society and education now. For that we need to generate the political will to act and that is what we lack. They will involve the organisation of the unorganised toiling people of our rural country side, from whom and for whom will emanate the society and learning system of the future - and not from us, the urban educated minority elite..

6. Prof. G.R. Damodaran, Dean of Post Gruadate Studies, PSG College of Technology, Coimbatore-641004.

SUGGESTIONS & RECOMMENDATIONS

1. Identify and list clearly the national goals on Science and Technology on a priority basis. Then formulate and set up educational goals and targets. Specify exactly the directions for educational patterns and programmes for the future.

2. Take up a detailed total assessment and review of Science and Technology education of the present in order to evaluate what has been achieved and where and why the educational system failed to meet the national objectives. Set up a continuing evaluation system and procedure for this assessment and review. Use a systems approach to determine the efficiency of the model.

3. Coordinate the educational system with national R&D efforts and industrial productivity. Carefully assess educational objectives in relation to the diversified needs of industry including that of providing a high order of technological leadership.

4. Determine exactly the qualifications and training the students should possess in the light of decisions regarding targets and strategies for R&D and innovation in science and technology during the next decade.

5. Emphasize creative and innovative thinking for the students in Science and Technology educational programmes. Institute handsome awards for best student

projects leading to new ideas and inventions. Make industrial training a compulsory part of curriculum..

6. Have a reappraisal of all scholarship and fellowship schemes in the light of current scientific and technological situation and in the context of the likely requirements and new orientation that the national R&D effort will take in the 70s and 80s. Such schemes may be designed on the basis of the vital development areas where educated and trained manpower must be channelled. This includes rural development and advancement schemes as priority item through setting up of research institutes for direct benefits to such areas.

7. Institute industrial parallel studies at all levels in all industrial - educational centres in the nation.

8. Draw a detailed scheme for continuing education for all practicing engineers and technicians and implement immediately.

9. Institute schemes for improving teaching effectiveness and for faculty preparation and training. Evolve a system for student fee-back.

10. Take steps to minimize 'Brain Drain' and to eliminate similar national losses.

GENERAL REMARKS:

1. The Committee must review and assess the formulation and development of policies with regard to -

a) the optimum investment in, and application of science and technology in pursuit of national objectives.

b) the organization of the scientific and technological establishments in the public service of India and the total R&D efforts.

2. Set up overall plan based on long-term projections and national R&D targets. Procedures and organisation of the planning, programming and budgeting system be improved to provide better assessment of the output of R&D activities and a better basis for formalizin such framework be established. This can be later tied to the educational system.

3. Keep a national R&D inventory and develop a national audit system for R&D programmes and projects supported by public funds.

4. Resource-based and primary manufacturing industries be supported to organize and to evaluate their innovative and R&D performance and to prepare every year a master plan to improve that performance in order to economize resources, utilize wastes more efficiently, reduce costs of production, discover new uses for their products, and further, to process these products for export markets.

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NEW CONCEPTS OF EDUCATION

By

Dr. Prem N. Kirpal*

He who ventures to read into the future must understand the past, especially as it is reflected in the present and in the continuing process of change and development that reveals the signs of the emerging future. The stream of history is an abiding fact of human and social existence that we cannot escape, and the sense of history is our only guide for imagining the future from its roots in the past, and from its manifestations and its becoming in the present. In the process of becoming, which is always the deep concern and the vital challenge of the present, all options are open because the spirit of man is boundless and unpredictable. But the spirit of man which is the very essence of his freedom and creativity has often bee feeble and dormant, and in this sense historical determi has had a validity one must recognize and concede. I believe, however, that we are now approaching that stag in the evolution of man where he can become the arbiter of his destiny by bringing into play and meaningful oper tion his free spirit, strengthened by new knowledge and strong faith. That is the purpose of education for tomorrow : to humanize life by imparting to it that dignity and quality which recognizes and respects the individual personality and broadens constantly the rang and scope of freedom and full expression for both man and his society. This is the firm faith from which we must start our quest for education of the future.

Such a quest cannot be the mere exercise of intellectual speculation or imaginative innovations unrelated to the realities of a society or the actualites of the educational system in operation. It must start by examining the relationship between education and society. It is often said that education should create a new society, that the failure of education is evident in the fact that it has not been able to develop a desirable society. Education is certainly a powerful instrument of change; but it is at the same time and more realistically and effectively the best way of maintaining the established order, and it is for this purpose of guarding and perpetuating the status quo that it has been used. Any system of education

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at a specific situation in time and space is mainly a reflection of the society that it permeates. Education makes society only if society has explored, chosen and found a new path and clear goals. Education cannot transform itself if society clings to the existing order, subsists in apathy, confusion and tradition, and resists basic changes needed for a new order and a better way of life. Judged by this criterion the existing system inherited from the colonial period of British domination and slightly tempered by a few frills and much shouting of idealistic aims and objectives, does fulfil its role of serving faithfully, and even efficiently, certain characteristics and features of our contemporary Indian society. I emphasize the society as it is especially its vocal sector of power, influence, and wealth, and not the larger and greater Indian society of silent acceptance, endurance and poverty. I speak of the society that actually operates and not of the pious hopes and not so pious professions of the rules and operators. Let me mention a few features of the established order of things.

1. Indian society continues to be hierarchical in in structure and character, maintaining provilege and inequalities. The income disparities have deepened with the years and the gap between the urban and the rural environments, and the gap between the individuals and the classes, tends to increase. The elite and the masses live in different worlds of thought and action. What has been aptly called 'the island republic of the Indian elite' rules the roost and there are not many signs of this privileged and alienated minority lossening its grip over the sources of wealth and the corridors of power.

2. Economic development, including social change but largely ignoring cultural development and quality of life, is the proclaimed goal of the ruling class. This race for progress is conceived on the same pattern and along the same path as experienced by the developed world and its industrial societies. The image of affluence and consumption and the life style of the materially advanced countries fascinate and inspire those who are obsessed by the idea of economic development borrowed from the West. Plans, policies and programmes are directed to this goal, and the necessary accompaniments of greed, waste and the rat-race of such a form of development are fully accepted, without much questioning.

3. The pursuit of such a concept of development, borrowed from alien cultures and conditions generates efforts to reproduce the scenario of industrial civilization in a predominantly rural society. The result is loss of originality, creativity, even reality, and the accentuation of differences between the few who enjoy the benefit of the development process and the many who remain impoverished and neglected.

4. A direct result of this imitation of the industrial society of the West is the emergence of a false and irrelevant model based on the transfer of technology from advanced countries, ignoring thereby the need for intermediate technologies and the search for diverse and indigenous sources of energy and more relevant forms of management. In this process scientific and technological education becomes a mere reproduction of western training and curricula, and industrialization receives unnecessarily high priority.

5. The consequent neglect of agricultural development and the conditions of life and work in rural societies naturally proves to be disastrous often resulting in shortage of food for rapidly growing population and further impoverishment of the vast majority of people living in villages.

6. The functioning of a democratic form of government in such circumstances leads to the emergence of a political system that encourages a sort of bossism and unscrupulous manipulation of the democratic process by power-hungry politicians. The political system is reduced to a pseudo-democracy indulging in the preservation of mere forms to the detriment of the real substance of freedom and participation.

7, The perversions and decadence of the political life are aggravated by the perpetuation of the rule of the bureaucracy and the authority of the generalist. This tendency is vividly illustrated by the virtual exclusion of the professional educator from the top management and planning of education, which are entrusted to politicians, bureaucrats, and old-school economists clinging to knowledge derived from the forgotten past of the London School of Economics and other similar institutions that have themselves transformed beyond recognition. Administration becomes inadequate, inefficient, corrupt and cynical.

8. It is not surprising that the development choice mentioned above should extend and sharpen social tensions, leading to general demoralization and loss of credibility of the rulers and their proclaimed policies. Faith and enthusiasm suffer and languish, while cynicism and apathy spread among all sections of people.

9. The undermining of spiritual and cultural values derived from living traditions as well as the idealistic goals and aspirations for the future damages both the moral fibre and the material achievement of society. The recession of values and the perversion of ideals deal a subtle blow to the very essence of education, which is reduced to lifeless activity lacking the luminosity of creative knowledge or the pulsating throb of inspired and dedicated action.

In the context of the choices, circumstances and tendencies described above, the educational system derived from the colonial past cannot itself produce any drastic change or fundamental transformation. It will, and even should, remain basically the same as it is now, if it is to maintain the present pattern of the life and values of society. Naturally, and this is evident from programmes and policies and announced periodically, some minor modification can be planned, and even introduced. Efforts can be made in order to improve the quality of elementary education, the vocationalization of the content of curriculum and expansion of technical schools at the secondary level, the qualitative improvement and provision of choices and facilities of higher education, wider and better utilization of educational technologies, modernization of educational management, improvement of teacher training, etc. Such reforms are good and commendable, but their efficacy will be limited by the constraints imposed by the social order and its directions and goals.

GOALS AND PRIORITIES

It is, therefore, necessary to alter and define clearly our developmental goals and national priorities for social, political and economic change, and this has to be done not merely by plans, slogans and proclamations but by real and urgent action and utter sincerity of purpose. Only then can the educational revolution outlined by the Kothari Commission's excellent Report and the latest vistas reflected so brilliantly in UNESCO's publication Learning to be (the Report of the International Commission on the Development of Education), begin to happen and take concrete form. Education follows social change and educational policies and patterns are determined by the over-all developmental goals. When these goals are clearly defined and generally accepted and are backed up by the necessary infra-structure and political will, the educational system responds readily to new needs, and becomes a potent instrument of social change. In India, the position is confused and clouded by a persistent and widening gap between thought and action, between aims and objectives so loudly proclaimed, and the policies, strategies and programmes of action lagging dismally behind.

A relevant and meaningful system of education will surely emerge and the many worthwhile ideas and objectives will be implemented if new social and developmental goals are firmly and honestly adopted and all national resources - material, institutional, moral and spiritual - are mobilized for the task of implementation.

The old colonial order should give way to the making of a really egalitarian society with a deliberate policy of decreasing income disparities and taking effective measures in favour of the backward areas and deprived groups of society. Rapid and ample increase of economic productivity, calling for positive measures, hard work and efficiency, is essential. We have still to harmonize the expansion of agriculture with the advance of the technological branches of the economy. For adequate economic development we must promote intermediate technologies and give the highest priority to mass employment and the best utilization of human resources. We need to develop and expand new paths and avenues towards the basic direct democracy in the overall ordering of society; only then can be realized fully the active participation of the individual in the life of the community and mobilize local resources for national ends. More complex but equally urgent is the task of shaping and harmonizing material, spiritual, social and individual values required for the making of a new society of free individuals in search of the quality of life from both the traditional roots of the past and all the fascinating possibilities of our own times. For the attainment of the quality of life we have to create conditions for the evolution and promotion of new human values and expend all the elements of a human and harmonious society. Problems of population explosion and rapid industrialization need to be tackled resourcefully and effectively in order to eliminate conditions which are constantly deteriorating the human and natural environment.

When and if such a scenario of developmental change begins to take shape in a spirit of dedication and determination, the transformation of education needed for a new society of new goals and values will be achieved effectively, and will surely contribute to its attainment. Educational change cannot be viewed apart from the social, political, economic and cultural goals of the community, which it must reflect and serve. A significant force favouring the genuine adoption of such goals and the honest pursuit of appropriate values and new tasks is now emerging in the form of a growing awakening among the student community. The deep concern and the keen awareness of students about the problems of society is a promising sign. One hopes that the idealism of the youth will be channelled into constructive and non-violent action.

Now, assuming that the present state of drift and confusion will give way to a sincere and purposeful effort to build a new society based upon social justice and egalitarianism, the choice and pursuit of a national design of living and quality of life, and the enhancement of the dignity and freedom of man, especially of the deprived sections of the community, what will be the main features of change and development in the educational horizons of the future? Blue prints abound and many sound ideas and recommendations have been formulated and frequently repeated in the past, and have indeed become the stock in trade of the politician. I shall attempt to highlight five main features which should dominate the scene of educational change and the making of a new social order in the coming years.

A NEW CONCEPT OF EDUCATION

In the first place our present concept of education which is derived from the plantation of an alien system for the limited ends of maintaining imperial rule and the status quo of privilege and social hierarchy, only slightly influenced by the new ideas and aspirations generated by the Freedom Movement, must now conform to present needs and realities, not only of our national society, but in some ways partake of the new global trends and problems that we share with others. We cannot escape the implications of what is often described as the world crisis of education created by exploding numbers, galloping costs, eroding relevance, and the emergence of new attitudes of the youth, rejecting the established society and its values and looking for new paths of liberation and social justice. A form of youth culture cutting across national characteristics and state frontiers seems to project a certain pattern of uniformity, of values and aspirations if not of forms and manifestations; and this emerging pattern, superficially expressed in diverse forms of alienation, anger and rejection, could rapidly acquire new strength and clarity of purpose from the rapid march of science and technology and the consequent revolution of communications. This new phenomenon of youth culture is little known and less investigated, but its educational implications cannot be ignored. In any case those who enter school today will work and grow up in the one world tomorrow.

Historically, the education of man has been confined so far to the process of transmitting traditional cultures and maintaining habits, customs, laws and values to safeguard the accepted ideologies, - whether religious, political or economic - and the social systems inherited from the past. The constraints and features of the acquisitive industrial society moulded the school and the university of today. Both the needs and possibilities of a post-industrial society and the powerful role of modern education as a liberating process have made the old systems inadequate and irrelevant everywhere.

Modern education is a process of learning from real life and from the pulsating, dynamic society around us. The learning should be at the choice and pace of the learner and proceed for all his life span through all appropriate ways and modalities available to the changing society. Education must stem from the roots of society, share its living conditions and problems and strive towards the fulfilment of its goals and aspirations. It is only in this way that education becomes relevant to life and can make its own contribution to the development of the individual as well as the well-being of the society. Life-long learning from all external sources and inner experience is both the process and purpose of education and the way of receiving and using one's learning determines the range and quality of the life-experience. The education of tomorrow will comprehend the multiplicity of learning situations and techniques, sharpen flexibility for quick and frequent adaptation, multiply manifold paths and choices, and endeavour to serve the ceaseless process of increasing our awareness, facilitating the full expression of personality and contributing to that impulse and urge towards transcendence which is the most precious heritage of India's culture and also the conscious and growing need of our own times. In all possible ways such a comprehensive concept of education should be applied wisely and resourcefully to the needs of man as citizen, as worker and as a person, enriching human relationships, developing initiatives and skills and above all giving full scope to that creative spark which expresses itself in the search for goodness, truth and beauty, thrives on freedom and solitude and gives meaning to the life and the vision of the individual person. This is a vast and complex task, but it is the only way for us to view the education of the future. The task may seem impossible to realize, but the endeavour is full of fascinating possibilities and calls for great adventures of thought and effort; and success awaits those who will do and dare.

EDUCATIONAL PRIORITIES

A beginning has to be made by a thorough review of educational priorities. The existing priorities as they operate in practice are wrong and lopsided, resulting in waste of scarce resources. In spite of high sounding intentions and well-meaning plans our actual choices are still in favour of the privileged classes of the community to the neglect or detriment of the deprived sections. Between class education and mass education we have neglected the masses, especially the needs of rural areas. Between the education of children and the education of the adults we have favoured the children of the well-to-do families. Between those who can afford full-time education and the working population, India has exercised the choice in favour of the privileged ones. Between the urban communities and the rural population we made the usual choice and neglected the deprived ones. Now if the basic socio-economic and socio-cultural options have to be made according to the needs of a truly democratic, egalitarian and forward-looking society - as they must, if we choose the new pattern of social goals described earlier - then the existing educational priorities have to be not merely altered, but completely reversed in favour of mass education. This implies decrease of growth at the university level, change of orientations at the secondary level, much stronger emphasis on the primary level, equalization between formal and non-formal education, development of adult education, and greater care of children at the pre-primary level. The highest priority should be accorded to the transformation of elementary education into a popular, mass movement linked to the needs of agriculture, rural development and adult literacy.

The reversal of priorities would be possible, indeed essential, only when some basic change in the economic and social field has been achieved. In the present state of our society, the colonial system of education is not only firmly entrenched; but contrary to the general view it has been more successful than the other sectors of the economy and the management of society. At least in terms of quantitative expansion and the limited introduction of some innovative features, education has outstripped the economy and the prevailing patterns of bureaucratic management. The problem of educational priorities also raises the question whether and in what measure education should be a resource of collective or individual consumption. On the answer to this question depends the responsibility of the community to organize educational facilities at various levels, especially the necessity of compulsory education, the provision of educational facilities for employed people, the organization of facilities at the university level, the bases and criteria for scholarships and fellowships, the discrimination in favour of the deprived sections, and the measures required for equalization of chances. In other terms, we have to reflect more deeply and systematically about the responsibility of the community - that is of the government and other social organizations - and of the individual in developing and using the educational programmes and facilities.

ROLE OF NON-FORMAL EDUCATION

The new concept of education and a sounder allocation of priorities raises the question of the place and role of what has been called non-formal education and its combination or coordination with the system of formal education. This need not mean any sudden or appreciable decrease of formal education. It does, however, call for a much faster growth of the non-formal facilities and modalities in the coming decade in order to correct the present imbalance and the long neglect of utilizing out-of-school educational situations. We need to create and develop all types of appropriate institutions, programmes activities, and personnel for non-formal education. This need is obvious. What is not so obvious is the corresponding task of deep and significant modifications of the structures and content of formal education. The development of non-formal education and its optimum utilization entails important changes in the curriculum and methodology of formal education and in the attitudes of learners towards non-formal offerings of learning. We have to establish meaningful links between formal and non-formal education in order to enrich, prolong and diversify the learning process without incurring the galloping costs of unbridled expansion of formal education, which often excludes or handicaps the deprived sections of the community.

Several bold and far-reaching measures have to be taken regarding educational structures, linkages and promotions inside the coordinated system, financial allocations, management problems and the priorities of action. Unfortunately, the latest Five-Year Plan, a truly dismal document, completely devoid of imaginative innovations and new methods of implementation, does not reflect this concern, and there is so far nothing on the horizon to show that the necessary action will follow.

NEW TECHNOLOGIES

This is specially regrettable when one realizes the large and significant possibilities of the use of new technologies of communication in a growing combination of formal and informal education. In a country like India with a large illiterate population, education cannot reach the masses through conventional and traditional means alone, and through the orthodox modalities such as class room teaching and text-book materials. Educational technology through the means and modalities afforded by the media of mass communication have to be used for educational purposes on a much larger scale. At present this is not happening, and the signs of adequate action are again few and discouraging. There are some half measures and a few modest efforts, but nothing substantially new or imaginative on a large scale and with bold conceptions is likely to happen. In the use of educational technologies we remain far behind other countries, including some developing ones. It is true that the evaluations of the educational impact of many media-channelled educational programmes does not show highly exciting results, and from the pedagogical point of view, in terms of knowledge, cognitive aspects and retention rates, the results are often disappointing. But there is no escape from the maximum possible utilization of the mass media for educational purposes if a nation-wide dissemination of knowledge, especially for the use of the deprived masses, is our aim. In any case the radio-television, satellites, press and films have a much higher educational potential than their present use which is negligible. The delay in developing the Satellite TV Educational Programme is the latest example of unutilized potential.

CONTENT AND CURRICULA

The proper use of educational technologies is closely related to the content of education and the diversification of the curricula or learners at all levels in different situations of both formal and informal education. It is positively harmful to limit the educational problem to structures, systems, logistic considerations and quantitative aspects as it is often done. The crux of the matter is the content of education which must reflect a different vision of the future. The content of education must correspond to the new concept of education, to the essence of the learning process, and to the linkage of man's future and the future of education. This involves a deep modification of all aspects of the contents and the curricula, including the objectives to be achieved and the methods to be used. In particular the evaluation procedures have to be drastically changed to free the content of education from the tyranny of examinations. The explosion of knowledge poses another challenge. The problem of content is indeed of prodigious dimensions, but there are hardly any signs of adequate response to this challenge. Our planners and reformers have given priority to structural changes such as the 10 + 2 + 3 pattern and the building of autonomous colleges, neglecting the far more urgent and important problem of reviewing the contents of education and improving the curricula which remain inadequate and outdated. The difficult question is how to alter the existing aims and practices of education which make the learner's experience so limited and lop-sided. We must move away from the present emphasis on more transmission of knowledge, dissemination of ready-made answers, regimentation, indoctrination, parochialism, etc. Educational contents have to play a dominant role in the process of self-realization and self-liberation of man, making him a free, responsible and transcending person, with ample scope for ceaseless enquiry, independent thinking and conscious choice of values.

APPROPRIATE INSTITUTIONS

I have tried to identify five major directions of educational change involved in the emergence of a new concept of education, the question of priorities, the role and extension of informal education, the application of new technologies and the transformation of the contents and the curricula which determine the process and quality of education. I now wish to draw attention to the new types of educational institutions towards which we should now move in order to achieve clearer and more relevant objectives and reach chosen goals. Many structural and organizational changes are required, but I would specially mention five new institutions which should be developed from our own social and cultural conditions as a part of our own national design of living for the emerging future to which India must contribute something of that quality of life which has often been the concern of its rich and composite culture in the past. These five institutions projecting the educational revolution are :-

(1) The balwadi or balbhavan, catering to the care of children at pre-primary level, with the active involvement of parents, especially mothers, and emphasizing the health, nutrition and play activities.

(2) The community school, linking the school with the neighbourhood, and education with work, while affording to all a basic cycle of general education laying the foundation of self-study and the capacity to adapt oneself to a rapidly changing environment.

(3) The people's college, offering choices of study and training and chances of recurrent education to all age groups, with emphasis on self-study and discussion and the seminar method.

(4) The community cultural centre, for participation in cultural life, including science and relevant technologies, and using new educational technologies and the mass media.

(5) The open university, which should reflect the extension and transformation of existing traditional universities, rather than the transplantation of foreign models on a limited scale as visualized at present.

Much can be said about all these five institutions, but I shall confine my remarks only to one, the Community School.

Among the many reforms needed to realize the new concept of education, perhaps the most important and comprehensive innovation is the community school, which has a special significance and urgency for the transformation of education in developing countries. India's educational and cultural tradition, reinforced by the more recent thinking and experimentation of Mahatma Gandhi and Rabindranath Tagore, point to the need and feasibility of the community school. Unfortunately, we paid only lip service to living traditions and new ideas, but continued to expand aimlessly the colonial system of education which had ceased to be relevant even at the source from which it had been imported. An educational revolution is now essential and one of its main instruments must be the community school, rooted in the social, cultural and economic environment, participating actively in the life of the community, serving to the extent possible and drawing upon local needs and facilities especially of mass education, work experience and culture, linking education with work and formal schooling with adult education, and above all, contributing to the national design and goals of development by mobilizing the moral, material and spiritual resources of the community.

The community school must offer to the age group of community education the basic elements of modern general education and of preparation for work which are indispensable for the continuation of education, either full-time or part-time, and for independent personal growth. At the same time the community school should be open to adult citizens and younger drop-outs who wish to broaden their general education or receive literacy and basic education which had been denied to them earlier. A certain uniformity of aims and objectives and a basic content of education is desirable but diversity is necessary in the programmes and functioning of the school, so that each school is in harmony with its own social background which varies from one community to another, giving rise to specific social, economic and cultural problems and possibilities in the local community. The diversity of these conditions in a local community calls for different patterns of organization, management and learning activities. The community school thrives on a certain individuality in the education programme and on the pedagogical creativity and initiative of the teaching staff and the local leadership. The school authorities should have the right to amend and alter the syllabi and curricula to a certain degree to adapt them to their specific needs. The school should endeavour to be the active agent and promoter in the fight against backwardness in town slums and rural areas. Apart from knowledge derived from books, discussions and teaching, it is necessary to devise methods of work and utilize situations in which young people learn to take initiatives and establish relations by working and participating in the life of the community. Work experience combined with some form of polytechnical education and the linking of learning with productive labour and other work useful to the community constitute the basic principle of education in the community school. The occupations within the framework of free activities which may be oriented towards science, arts, technology and sports. The success of the school would depend largely on the interest and involvement of parents, active members of cultural and sports organizations, artists and craftsmen, scientists and professionals, and members of social and political organizations. The inclusion of farmers, craftsmen and industrial workers in the organization of pupil's indoor and outdoor activities is important. The role of pupils, teachers and parents should be clearly expressed in a democratic type of school management. Great care should be taken in evolving the right mechanism for the elaboration, development and evaluation of curriculum and syllabus content of the school's educational work the young and adult inhabitants of the locality.

The idea of the community school is still in an early stage of exploration and a great deal of research, planning and experimentation is necessary. Adequate organizational and technical preparations, including sound and imaginative use of educational, psychological, human, economic and financial and socio-political factors, are essential for success. At the same time it is necessary to move speedily and spread the movement everywhere. The community school can contribute to the creation of a social climate favourable to a change in the community's attitude towards education. The absence of such a social climate has stood in the way of educational reform and renewal in the past. The community school can also promote significantly crucial programmes of family planning and food production which languish for want of wide and sustained support from the broad community through its institutions of mass action and educational publicity.

Undoubtedly some thinking and even limited actions have been directed to the half-hearted measures for the care of children and the education and training of the adults, but no appreciable change took place and no break through could be attempted in view of the elitist structure and values of society, the colonial style of administration and the traditional policies of the State. What is now needed, if new social goals and right objectives are adopted with clarity and conviction, is the opening of all educational modalities to the use and welfare of the masses of people, and to this end the bal bhavan, the community school, the people's college, the community cultural centre and the open university could make effective contributions. The pursuit of the five directions of educational change outlined earlier and the building of the five new institutions, backed up by small number of specialized institutes and centres for training and research at the highest level, would fill my horizons of the educational future. I must also mention the fascinating possibilities of our participation in the development of a United Nations University net-work around the world, located in campuses and centres that are ready to create conditions and facilities for promoting international cooperation and global tasks, through research, study and training.

MODALITIES OF ACTION

The educational horizons are clear and exciting. The problem is how to reach there; and this brings me, in conclusion, to the question of modalities of action and change. Here again I shall mention five problems of modalities of implementation :

The Problem of Resources. It is well known that ever since Independence the educational sector of national life has received extremely modest financial resources. The per capita cost of education, especially in the area of mass education and college education, has been about the lowest in the world. The little over three per cent of the GNP currently spent on education is also among the lowest even in the developing world. We must now increase appreciably the share of national wealth for education. For this purpose it is necessary to explore and deploy all the possible modalities of the environment and considerable potentialities of linkages between different sectors of economy for the enhancement of material, financial and intellectual resources at the service of educational development.

Educational Planning and Policy Making. The search for the educational future cannot be the way of lucid improvisations, vivid and visionary contemplations, and brilliant intellectual speculations. There is need for solid investigation gathering of reliable data, and scientific research as well as for realistic innovations and bold experimentation before options can be made in such a delicate and complex area of human experience as education. The UNESCO Report Learning To Be rightly observes :

> Any educational policy reflects a country's political options, its traditions and values and its conception of its future..... Expounding an educational policy is the end result of a process of thought which consists in : (a)ensuring that educational objectives comply with over-all objectives; (b) deducing educational objectives from aims approved in over-all political policy; (c) harmonizing educational objectives

> and those adopted in other sectors of national activity .... We may then move from the policy phase to the strategic phase ..... The object of strategy is to transcribe policy into a body of conditional decisions, determining action to be taken in relation to different situations which may arise in the future... Drawing up a new strategy necessarily presupposes an overall diagnosis of the state of education.

This way of sound planning is unfortunately not yet the way in which the educational policies of India are made and elaborated. We are not equipped, either scientifically or logistically, to start the building of the educational future in a systematic way.

If we are to embark upon a meaningful search of the future goals and patterns of our society, and in that context to shape the future of education, it would be necessary (i) to put emphasis on tools and means for identifying the future rather than the mere process of inventing or imagining it (ii) to put emphasis on research and investigation of alternatives and innovations instead of trying out ready-made solutions; (iii) to involve all force (political, scientific, economic, pedagogic, etc.) and parents, teachers and students in the vitally important task of reshaping our education. In the planning of education we have to think not only for today and tomorrow, but also in terms of middle-term and long-term perspectives. The planning and management of education must be entrusted to specialists and teachers rather than the generalist type of administrator, who has neither the skill nor the will to innovate.

Educational leadership. The broad and comprehensive education of the emerging future cannot now be the responsibility of the ministries and departments of education and the ruling establishments of universities as they are organized at present. The monopoly of the State, and of the traditional institutions and the professions must give way to the pluralistic role of more diverse, democratic and relevant authorities, patterns and institutions. It is often argued that education should be a national responsibility and not a state subject as it is now allocated by the Constitution. In a country of the size and diversity of India, the states of the Union, and even the localities of the district level, have to play a primary role in the sphere of education. But there is certainly need for overall national policies, comprehensive planning an some supervising authority to enforce implementation. It will be necessary to establish inter-ministerial bodies for education and the whole field of human resources under the guidance of leaders whose authority will ensure inter-ministerial cooperation and prompt action for enforcement of policies. Leadership at all levels and within the diversity of institutions and local situations will be crucial.

Participation of the Community. Education can no longer be the prerogative of educational authorities alone; nor can the task of implementation be the sole responsibility of the educationist. There is need for wide participation in decision-making and in the practice of education by all concerned, such as teachers, students, parents, employers, potential users, learners etc. There is no democratization of education unless the broad spectrum of people have the right to participate in the management of their educational institutions and in the evolution of educational policies. The progress made so far in this direction is quite negligible in India and a great deal of planned action is an imperative necessary now. Apart from the setting up of a few committees in some universities and some very general suggestions formulated by a UGC committee nothing of any significance has been achieved so far in bringing about the participation of students in the management of higher education.

The Political Will. Lastly, the emergence of a political will to transform education and to make it more relevent to the needs of the individual and of the community is of over-riding importance. Such a will has been singularly lacking since Independence, and by and large those wielding political power gave little more than lip service and platitudes to the cause of education.

Prime Minister Indira Gandhi has said:

> One of the biggest mistakes we made when we gained Independence was not to have overhauled thoroughly our educational system and structure. We are paying for it now... We have first of all to think of what is education and what we want education to do for us. No doubt there is need for good institutions, for good schools and colleges and universities, but education is not something which is confined to the class-room... One is learning continuously from what is happening to one or around one : from the people with whom one is mixing, from the books one is reading, and even from the events of the world which may take place far away. And it is this ability to learn which is true education. Whether you are in the factory, whether you are working in the field, education must continue... It is no use your learning something if it is going to be locked up in yourself. It should be used for a purpose and unless you can use it you will not be happy.

These are wise words from which a new political will may possibly emerge. The responsibility of the political authority is all important and decisive, and if we have to build a new future for education and for the larger society twenty-five years hence, we must begin today, and there is not a moment to lose. Let no one say after the next twenty-five years that we made the same mistake regarding education as was made in the first quarter century of India's independence.

DISCUSSION ON THE PAPER ENTITLED

"New concepts of Education" by Sh.P.N.Kirpal

by

P.N. Murthy, Prof. & Head of Aero.Engineering
Department, IIT, Kanpur.

1. The paper is a very erudite presentation and highlights many important aspects of education in 2000 A.D. It traces the past ideas and points out the shift in emphasis that should be brought about if education is to be meaningful In this note I would like to supplement some of the views expressed in the paper.

2. The author makes the point that education has generally helped to maintain the status-quo in society. It is difficult to support this statement completely.

The relationship between education and society is integral. Education is the process devised by society to transmit to its members the knowledge accumulated from the past to be used in the present and shape the future. For the individual this will mean training in gathering and correlation of information, assimilation of experience and creative projection of ideas and activities. Any system trying to achieve these ideals should have form and content compatible with each other. Also, it is well known that every system contains the seeds of change. The first thing that happens in any movement towards change is a disturbance in the compatibility between form and content. If each one changes by itself, it will be difficult to discover a compatible system. Then society and the educational system which is its instrument of light will be out of step with each other.

It is well known that inertia is a characteristic of any natural system. Resistance to motion and change is its basic property. Strangely enough, the measure of inertia in physical science, is the product of acceleration of the body in motion and the mass of the body: higher the acceleration, higher the resistance. Unless the frame of reference is changed, this law cannot be overcome. In human terms, this in my opinion, means that the frame of existence should become spiritual, when man and his environment will become mutually harmonious and helpful. A complete dynamic equalibrium can then be established, moving constantly and continuously towards the goal of enlightenment, self discover social harmony and prosperity. Social existence and goals will be completely compatible with personal activity and ambitions. Till that is achieved, it is only dynamic disequalibrium that marks any social change. The system will throw up contradictions and suggestions for change. Powerfu

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products of the system will work for the change while equally strong elements resist these attempts. Change will be achieved through a mixture of some peaceful persuasions, some gruesome tremors, shocks and violent disturbances. This kind of journey to peace and harmony can be avoided only when human consciousness rises to spiritual levels. Till that time the struggle has to be gone through patiently. It is no use blaming any particular component of education or society.

3. The present crisis in Indian education refers to both form and content: form because of the change in the audience to be reached by the system and content because of the post industrial technology to be transmitted. The present system benefits neither the elite nor the commoner. The elite cling to it because of an illusion and the commoner opposes it because of anger. It is still able to resist the pressure of change because of the inherent strength in the very idea of education. There are some permanent values like self discovery, elevation of human spirit, creativity etc. that any system of education makes an attempt to uphold.

4. The author goes on to say that the early planners had laid too much emphasis on the western concept of affluence achieved through industrialisation ignoring the agricultural character of our society. It is true that any plan for growth should be firmly based on the reality of the present. But this should not be to perpetuate the present social material balance. Even in the west, the pre-industrial era had been agricultural. Slowly the base was shifted by conscious planning, to major activity in industry. Now a minority of people produce large quantities of agricultural products sufficient to meet the food needs of society. Many people had been diverted to industry from agriculture with benefit to both. The early planners of our country tried to benefit from this experience while investing large amounts in agriculture in the early plans. The fruits of these efforts were spoiled by two factors: (i) fast population growth and (ii) mal-distribution of generated wealth both in the agricultural and industrial sectors. Agricultural societies are inherently more heirarchical than industrial communities. Unfortunately, it is the leadership thrown up by these agricultural communities which has virtually perverted and polluted the political life of the country. However, one must accept that these communities have also given the needed stability for development.

4. Our leaders of education have not also shown perception and vision of new society of the future in any of their plans. The reports of the commissions have attempted only marginal adjustments in the existing patterns and structures. Most of the time the effort was to improve the efficiency of the existing system by giving incentives to teachers to increase their motivation, and by devising better methods of teaching

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survival if not by conviction.

9. Priorities in education can be decided by examining the implications of the goals of education stated earlier. Acquisition of technological skill and assimilation of spiritual values do not demand the present division into three distinct levels, primary, secondary and higher, in all cases. Most of human productive activity is at the low and intermediate levels of technology. These do not require a high degree of academic preparation to acquire the necessa skills. On the other hand high technology requires a mature foundation in sciences, before the technology is transmitted. A recognition of this makes it possible to adopt several mass communication techniques to train the members of the future society. The priorities, as stated in the paper, are no longer rigid but become flexible depending upon individual needs and situations. In fact, all levels have to be simultaneously encouraged. Sometimes an individual may be learning simultaneously at the three levels.

10. The author goes on to discuss very elaborately five forms of non-formal education. I would like to suggest one more which might prove useful.

Any system of education should optimise the existing resources for education and also give room for individual aspirations and aptitudes. As said earlier, an individual likes to educate himself for at least two reasons: (i) to acquire a skill which will make him a productive unit and (ii) to acquire a set of values to govern his life. In ancient days the first objective was realised mostly throug hereditary instruction even in areas like medicine. Some formalised instruction seems to have started with the establishment of universities like Takshila, Nalanda and Amaravati. The second one was realised for the large mass of people through organisation of mass communication metho like public shows, story telling, dances, kalackepams etc. Even today in India the preservation and transmission of cultural values is largely through these ancient mass communication techniques. These are being modified and adapted to the modern technological tools like radio and television.

The method of training adopted in the ancient days has a simple basic feature and philosophy. The student learns in a real environment under a teacher who is practi sing his trade. The student lives with him and imbibes bo the personality and skill of the teacher according to his capability. The teacher transmits all that he knows. If the student wants to know any further, he goes to another teacher of higher standing and reputation. These are, therefore, working teachers and working students.

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As society deveoped, the life styles became more complex and learning was formalised interms of institutional programmes. Even here the ancient universities seem to have preserved this concept of 'Gurukula' to the extent possible. The teachers lived on the campus and students were attached to them.

11. Can we adopt this as one of the educational techniques? In my opinion, we will need to bring this conce into active operation in the next twenty five years. In 200 A.D., people seeking technical and higher education will be as many as 50 million. If the present teacher student ratio of 1 to 10 is to be maintained, about 5 million teachers wil be needed. This is almost an impossible task to achieve bot in terms of numbers and financial inputs. So alternative training methods have to be found. Apart from those suggest in the base paper, one may have to use all professionals in various trades including management, adopting the Gurukula technique to train required number of skilled workers.

Even today, the chartered accountants are essential following the above pattern. A trainee enters a chartered account's firm after acquiring some preliminary background in the art of accounting. He is trained by the practising accountants in the firm. At the end of the training, the trainee takes the examinations given by a professional body and gets accredited. Similar arrangements can be conceived in the case of other disciplines and technologies also. Alvin Tafel, the author of the famous book 'Future shock' seems to suggest a similar idea when he talks of mentor schools'.

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EDUCATION: 1975: 2000 A.D.: DISCUSSION - POINTS

I - THE EDUCATION SCENE 1975 - ITS POTENTIALITIES AND PROBLEMS.

By Dr.Kunthala Jayaraman*

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"Human history becomes more and more a race between education and catestrophe" - H.G.Wells.

An attempt to put all the salient features of our educational systems in this slim paper means that the amount of information missing from these pages is almost without end!

POTENTIALITIES:

Indian Education Institutions today are manned by the first generation Indian Faculty who are trained in a permissive and progressive atmosphere. They are our national assets. The most rewarding aspect of the situation today is that during the past 20 years we have been able to build some infrastructure necessary for our education. If, in the process we have missed the importance of having to keep pace with the changing times, it is a fault that can and ought to be rectified soon enough. If one looks at the number of persons registered for our graduate degrees in our country which is around 30 lakhs (1973), this represents an average figure of 3.8 Indians per every thousand which is a very low number indeed. Naturally, the number decreases in an alarming proportion as one looks at the higher educational levels(1 Ph.D. enrolled per every two thousand individuals). Thus we have just started on our work.

2. We have also managed to generate a set of people who are clamouring for change, not because it is fashionable, mainly because it is feasible. We are confident that we could identify our national needs and solve many of our problems in a creative manner. The successful thrust in the field of nuclear physics, electronics and space technology has been possible on account of the freedom enjoyed by the scientists in this field, clearly arguing for the need for a more decentralisation of our educational framework.

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* The author is the member of the NCST Panel on Futurology's Technical Sub-Group on "Education".

Note: This background paper is for discussion at the 2nd meeting of Education Technical Sub-Group to be held on August 19, 1975 at Technology Bhavan, New Delhi.

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3. A sober look at the staggering figures involve
at the various levels of our education in our countr
reveals that we are doing a reasonably good job of m
an impact of the urgent need for the educated indivi
als in our society. Considering the ratio of the
teachers to the taught, one can visualise the enormo
amount of individual efforts that has gone into this
task. We have also taken the right step in the
introduction of Science Based Education, a dire
necessity in these days of modern-technology based
society.

4. I also believe that in terms of cost affective
the cost of education in India is the lowest in the
This may have emanated out of making a virtue of nec
engineered by human endeavour, but the fact remains
that we have learnt to operate from a low budget-lev
which makes climbing up process easier and more assu
rather than having to climb up with lowered financi
involvements, a situation true of several African an
Asian Countries. Several of our national educational
have been diligently executing their tasks. Conside
the odds they have to work against, fighting the
frontiers side by side battling for mass education.
high standard at the several higher secondary school
all over India is a classical example. The emergenc
laboratories in Universities with clear cut speciali
tions and international reputation is again an examp
of our capacity in the various fields of education.
Serveral National Institutes have also acquired unas
able fame and technical expertise.

SOME OF THE PROBLEMS ASSOCIATED WITH OUR EDUCATIONAL SYSTEMS:

5(i). India has one of the largest educational syst
in the world and it is true that the rate of student
enrollment in the universities and schools are incre
in an alarming manner. We are not able to cope up w
the situation under the present staff to student rat
For example, the staff to student ratio in humanity
1/26 and in science 1/20 at the graduate level.

(ii) Our resources are low(i.e., about four thousand
lakhs per year for the collegiate education level).
We have lack of trained individuals and lack of oppo
at the higher levels(the number of university facul
in India runs to a figure of 24,000, 70% of them bel
to the lecturer cadre of employment while only 10% f
the Professor ranks). At our colleges we have 1,26,
personnel employed. Again 80% of them are at the le
grade while senior teachers from only 13% of this po
lation. Clearly, we lack two categories of the teac
personnel:

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(a) the advanced level personnel and the trained technical persons capable of operating at the intermediate level.

(iii) Our enrollment in the universities is tending towards science oriented courses(30% of the total enrollment). But the majority of our students are enrolled in the courses in humanities(59%). This trend is not forseen adequately and appropriate increase in science faculty is to be met with.

(iv) The main problem that beset our youngsters today, is that they are asked to take a decision regarding their career, too early in their life. They are condemned to be biologists, or a mathematician or a doctor, at the very beginning of their higher education. Several binational conferences held in our country in various subjects like Chemistry(1969), Physics(1970), Biological Sciences(1971) and Mathematics(1971), where several experts in these areas conferred and came to the conclusion that education at the under-graduate level need to be more broad based and inter-disciplinary programmes permitting the students to understand the ways of thinking that are common to all branches of science, rather than to emphasize technical distinction that set one branch of science from another. Nobody could predict what sort of scientific training our students should have in order to meet the challenging world of 2000 A.D. We could only adapt the principle that the more broad based their education, the greater the chances of their adaptation to their environment. This must be emphasized as a principle change over in our educational system.

(v) Our universities are facing the same crisis that several other universities in the world are faced with today. There is the crisis of numbers, finance, relevance, priorities and sceptics. To provide education that is relevant to the changing demands is a costly business and a vicious cycle. This only speaks for the success of the university systems as more it meets the needs of the various public, the more demands are made on it. As we say, "we could only beat a walking horse." They need help.

POSSIBLE REMEDIAL MEASURES:

6. The main reason why no one solution of the problem of educational reforms is applicable is clear from the fact that one is dealing with the problems of different magnitudes. At the lower levels of education, namely at lower and middle schools, obviously we have to think in terms of group therapy as a large number of individuals are involved. Different approaches of educational pattern such as vocational education, non-formal education and formal education inclusive, should be tried. A different yardstick naturally applies to the programmes at our collegiate level. At the university education, a topic with which I am more familiar with, one could clearly point out that our under-graduate programmes are the weakest

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link in our educational system. A broad based science cum humanities curriculum with sufficient freedom built in for t students in choosing their courses is the most important recommendation this sub-group should make.

7. It would be wise to adapt two principle lines of action to make education a means of creating the right type of manpower to our country:

(i) Identifying the weakness in our existing systems, strengthening them and intensely diversifying them.

(ii) Pursuing functional elitism. This is going to be our major achievement as the youth will be assured that when their abilities are demonstrated, they will be recognised and this is something to strive for. This need not be mistaken as anti-democratisation of our educational systems, but principally aimed at producing a feeder system where by talented personnel from all walks of life could be identified and fed back to make a better educational environment.

MAJOR THRUST RECOMMENDED:

8. In order to accomplish many of our future aspirations in the field of education, several important issues have to be clarified so that the planners in the field could have a clear idea of their scope and limitations. Some of the national policies that must be discussed and our views must be made evident as an outcome of these discussions. They include:

(i) Creation of an atmosphere of financial and professio satisfaction of our teachers in our academic system, to enable them to carry on with this task of making a useful citizen of his pupil. Could one expect a starving village teacher, far removed from places of opportunities like cities to show much enthusiasm in his task?

(ii) Institution of uniform national levels of eddcation all over India must be emphasised. A uniform patter of schooling and college education, at least in the number of years must be standardised. Furthermore, free movement of the students from one faculty to another at least within an university must be encouraged. This calls for new types of management concepts at the various institutions.

(iii) Organisation of several programmes in our educationa pattern aimed at all levels must be encouraged. The successful attempts in the past and the present like quality improvement programmes in technical educatio

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and college science improvement programmes and faculty improvement programmes in collegiate education, are noteworthy in this respect.

9. We do have our national agencies like NCERT, UGC, CSIR, ICMR, DST, etc. looking into the problems and these have set up successful infra-structures capable of looking into several of the identified problems. What we need is a feed-back of ideas between these agencies and the establishment of more autonomous units within these national bodies so that execution of short term programmes in a target oriented fashion could be accomplished rapidly and successfully. Education is a changing feature of humanity and such changes need a more dynamic approach to solve these problems.

TERMINAL NOTE OF ANGUISH:

10. It is exceedingly distressing to have persons in every walk of life accusing the educational institutions that the education today is meaningless. Slogans like "job oriented education", and "relevance" is being echoed everyday in every newspaper. Let us try and define what we mean by education. If, by definition education involves a complete insight into the knowhow of the various branches of science and humanities, I admit, we have not completed out task of fully educating our young persons. If however, we mean by education, a process of learning and not of mastering, then I believe we are attempting the task. It is by diversifying the process of learning that one hopes to achieve a creation of masters and enquiring minds.

11. Regarding the issue of relevance, todays relevance need not necessarily be tomorrows relevance, especially in our changing society. Are we going to be victims of the changing demands of the society or are we going to be able to set separate goals and create a learned society? It does not mean that we are living in an utopia where everything that need to be done for education has been done. No, on the contrary we have just begun our task. We would like our academic instituions be frontier posts as well as service station. A difficult problem to deal with. Let us device means for accomplishing both these goals

undergraduate level. A uniform pattern of education, at least in the number of months spent in each course in the form of semester or trimester periods must be immediately implemented. While an institution or university is free to draw up a requirment for basic programmes they should be at least a 30% option available for the students.

3: Link-up between Educational Institutions and Small Scale Units:

It is well known that several States, particularly Maharashtra, Delhi, Punjab, Haryana and Tamil Nadu have established a very vast net work of small scale industrial units throughout their states i.e., at least one unit within every fifty miles at least. It would be a very interesting experiment to see if some of the major schools in that area could be asked to link their teaching programme with a part-time training in these institutions so that during the high school education, the students could acquire professional skills of diverse nature.

4: Enhancement of scientific awareness of the community:

Establishment of science education centres in large towns
coupled with science museumsherein students have an
opportunity to see and learn about scientific discoveries
would be a very good incentive to develop the younger
minds towards science and based education. The museums
could be manned by sufficiently skilled scientific and
technological staff, thus providing for additional job
opportunities for these personnel. Encouragement of
the post-graduate students in the city areas to demonstra
their project work in these centres with due publicity
given for such activities would attract a fairly large
amount of a crowd who could witness living science. Thu
for example a one-week programme by the technology
students, followed by another week's programme by the
biology students, followed by physics students, etc....,
would provide a continuous series of experiments in
these science centres where facilities will exist their
display and discussion.

USE OF NEW SPAPER MEDIA:

Unit courses in the form of a short illustrated series o
newspaper articiles could be offered by the Universitie
that the public is free to take these programmes for th
mere cost of the newspapers; at the end of the year, th
universities could conduct the examination and award
certificates for those who meet the requirement in thes
unit courses. This will have a very wide circulation a

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since it would also enhance the circulation of the paper, the cost involved may be minimal in these programmes: Regional papers could also be empoued for the purpose where the lessions could be in regional languages. Possibly Universities with special correspondence courses could be the first ones to try this idea.

MAXIMAL UTILIZATION OF THE EDUCATIONAL INSTITUTIONAL FACILITIES

The weather conditions and social habits in our country has been deterant so far in the maximum utilisation of the daylight hours in our educational institutional and administrative offices. In view of the situation that there exist a great demand for education in our country., perhaps it may be worthwhile to explore the possibility of making institutions to function on a shift basis. By doubling in the faculty strenght, as well as putting in a little more input the facilities, it is possible to optimally utilize space in these institutions.

Naturally, to make this possible it may be rather nice if we could possibly air-cool/air-condition, the educational institutions, and laboratories. It may sound as a costly venture and also arguing for a luxury at a time of economic stress. On the contrary, if one looks at this idea carefully it is clear that by maintaining a coler temperature, the efficiency of the teaching personnel, the taught and the equipment, which are often very costly, is maximized. By operating a dual shift system in a day it's possible to have a repid utilization of manpower and materials and thus the cost-effectiveness of such venture is bound to be much more rewarding the elitism of the educated. It is well known that the most efficiently functioning industries have their offices and workshops air-conditioned and even necessarily sound proofed so that the workers turn out their best. It mus be viewed that education is an industry indeed, to turn out informed future man-power of our country. This could have its spill over in the development of cryotechnology through the use of solar energy.

ITEM: EDUCATION: 1975 : 2000 A.D. : SOME DISCUSSION POINTS FOR THE TECHNICAL GROUP OF FUTUROLOGY ON EDUCATION.

By Prof. B.M. Udgaonkar*

1. One advantage of discussing the situation in the year 2000 A.D. is that one may be able to disentangle oneself from the problems of the immediate present and define some desirable objectives including structural changes which look unattainable in the immediate future for varied reasons. The following problems which arise may be discussed in this context.

2. Resource allocation in Education:

(a) The question of raising the investment in education from 3% GNP to the often suggested level of 6%.

(b) Optimum distribution of the resources into the primary, secondary and tertiary sector, especially in the context of the unfulfilled constitutional directive regarding hundred per cent enrolment upto the age of 14.

These questions are very pertinent from the point of view of the development of the human dimension of economic growth.

3. The question of delinking degrees from non-professional and non-technical jobs: Could one persuade the government to adopt a declared policy of not demanding degrees for a wide variety of jobs? Could one persuade the UPSC not to demand a degree from those who appear for various competitive examinations including I.A.S. etc.? The point here is that it is difficult to envisage that the craze for degrees will go away unless the degrees are not considered necessary by job givers, including for the more prestigious jobs.

4. The question of defining Appropriate Education for Appropriate Technology, in relation to desirable life-styles that may be contemplated for the year 2000.

5. The question of removing the fragmentation of the national educational scene, e.g.

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(a) Education in Arts, Science and Commerce comes under the purview of the UGC. The technical education is dealt with by the AICTE and medical and agricultural education are dealt with by other bodies.

(b) This situation not only makes educational planning difficult but, at a time when there is so much talk o vocationalising education, it presents considerable difficulty in diverting students from the conventiona Arts, Science and Commerce streams into vocational streams.

5. The question of strengthening the coupling between the educational institutions and society's resources in National Laboratories of various Agencies, Industry, farming and commerce so as to make education and research more 'rele In this connection, one may consider, for example, the conce of practice school which is being tried by the Birla Institu of Technology and Science, Pilani.

6. The question of making N.S.S. an integral part of education.

7. The new University structures that would enable educat institutions to be more dynamic and innovative.

(a) Academy decentralisation, through autonomy for University departments and colleges.

(b) Training of future University administrators from amongst good academics who have a flair for administration.

8. The question of making education, in particular, medic education, relevant from the point of view of rural developm e.g.

(a) Could each medical college adopt a certain rural area for its care, with medical students attached to families and following up the health problems of those families in the course of their career in the medical colleges, over the years? (Such an experiment seems to have been tried successfully in Turkey and on a small scale at B.H.U.).

(b) Similarly, could every University and college, possibly in collaboration with the National Laboratories, adopt districts or talukas or villages for all round development? This could

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be an extension of the ideas behind the Karimnagar project.

9. In a situation where education has to be a lifelong process, the question of educationalisation of vocations as distinguished from vocationalisation of education. One may here consider the role that universities can play in various programmes of continuing education on an increasing scale, as a normal and important part of their academic activities.

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Education 1975 : 2000 A.D.

Education and Human Resources

by

Prof. J.T. Panikar*

There are moments in the life of a mation, when that imperatives of the "Status of Man", and the compulsions of her own history, demand in pressing terms, whether the capabilities of the present could structure the possibilities of a future. Man reasons for a "Logical future", but deep within, he struggles to create a "Willed future", where the inadequacies of the past and the omissions of the present, do not restrain him from foreseeing an environment for "Total Man".

Natural resources are no more "infinite", and warnings of great caution are being voiced constantly on the planet's decreasing ability to sustain a life styl of ever increasing production and consumption. Developme of human resources in the changed context of enhancing the universal capabilities of man to live a life of self-realisation within a system of "ecoharmony" needs the adoption and practice of a much higher level of values system. Education is our biggest endeavour, which affects the largest number of people, for the longest part of the individual life span. It is the starting point, a sure foundation and the sustaining principle for any attempt to a "willed future". It is vital at this juncture to see, how deep in time we can probe to the future, and how completely we can profile the possibl options that might unfold for the future.

Any discussion on education might start with the main objectives with which the system is planned and run. The encapsulation of students within a formal school syst and projecting along a time range forms the main structur of this process. In this effort, equality of educational opportunity could be regarded as a goal or a set of guide-posts in the sense that framing and implementation of educational policy should introduce measures that will contribute to an increased equalisation in educational participation and even more so in educational achievement. What matters to the student "is not how equal his school is, but rather whether he is equipped at the end of school to compete effectively on an equal basis with others, whatever his social origins". This would mean that equally effective schools, whose influences will overcome the different social groups. This implies differential pedagogical treatment.

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* The author is member of the NCST Panel on Futurology.

Note: This paper is for discussion at the 2nd meeting of Education Technical Sub-Group on August 19, 197 at Technology Bhavan, New Delhi.

Structure of Abilities:

In psychological terms there are two major types of ability usually defined : practical-vocational and academic theoretical. The former type is believed to suit mannual occupations, whereas the latter type gets along more easily with the printed and written world and feels more at home in the thin air of abstractions; The two types of ability have been traditionally conceived to stand in compensatory relationship to one another. Modern differential - psychological research does not support this view, but on the other hand says they are positively correlated at a modest level. An individual who performs will academically also tends to perform well in practical concrete tasks. In a modern complex technological society with increasing demands on educated ability and the progressive "academisation" of what earlier were unskilled occupations we note a tendency towards an even closer relationship between the two types of abilities. The earlier marked dulaism between vocational and academic programmes and tracks is now yielding to a merged comprehensive programme.

CONCEPT OF TALENT:

It is the general practice to conceive talent mainly as academic talent, that is the ability to move ahead in the formal educational system. Studies in depth on student performance are proposing a more criterion-oriented approach to define talent in terms of "socially relevant performance". Under this criterion talented performance, consists in achievement or action which is judged to be of intrinsic value to the self and society. Conventional scholastic aptitude tests limit themselves to one type of talent, and leave out non-intellectual, including motivational factors. The major point in this study is the change of value priorities in conformity to the values of existing societal norms, to having the focus on values conducive to much greater self-realisation. It is true that academic attainments in terms of examinations and grades play a dominat role within the meritocratic pattern and therefore while defining "talent" as "socially relevant performance" one cannot make a strong case to minimise academic performance". At the same time it is necessary to point out, that a high-school senior with high grades or aptitude scores, not going to college, does not necessarily mean that his talents are lost. He might have another type of talent, that is more developed and more cultivated by a higher level of interest and motivation than his academic potential. It would, therefore, be more justified to define "loss of talent" as the "non-utilisation of those personal capacities which are necessary for the occurrence of socially significant performance."

The existence of "Reserve of Talent" defined as the ratio of those of lower-class origin with superior school performances, or scores on aptitude tests who did not enter higher education, revealed by several studies is a striking indication of inequality of educational opportunity. In the realm of human resources development, the identification of talent, the assessment of "reserve talent" and the facilitation of students from less-privileged backgrounds to get into the forward areas of the academic main steam, and into university is the supreme need in terms of social justice. We need to enter a new and bolder environment where poverty need no longer exists, and where education is the vital pre-requisite for clear thinking. Government when formulating a strategy for education, should take into account, that science and technology have released forces which are of staggering power and that human beings must benefit from a better education than in the past if they are to harness these forces to the well-being of the country.

Alternative Educational Futures:

The "alternative educational futures" approach is different from the long-term educational forecasts. Long-term forecasts have mainly focussed on relatively few, easily quantifiable variables such as, enrolments rates, graduates, new entrants, global expenditure figures, and they are mostly single-valued. The wider environment in which education operates is taken into account only in a rather partial way. On the basis of "scale-forecasts", decisions are taken on the number of places, as well as teachers and other resource inputs. At the same time more qualitative changes are being introduced to meet a variety of objectives. They concentrate mainly on demographic and economic variables and assume the future will not substantially differ from the present except within the limits prescribed.

This could be termed "future-as-an-extrapolation of the present". Exploring alternative educational futures does not mean making longer-term forecasts of t-he a-bove type. It would include:-

i) Trac-ing through the f-uture consequences of current anddforseeable decsion. This is an exploratory approach.

ii) Mult-i-dimensional goal assessment and alternate strategy consideration. This is a normative approach. // The main feature of this approach, besides its very long term perspective - is its attempt to concentrate on issues, values and goals a nd to trace their quantitative and qualitative consequences back to the educational process.

The purpose for "futurologic studies in education" can briefly be said to be:

i) identification of future consequences of present planning andpolicy decisions,

ii) to go beyond the traditional exploration of numerical trends,

iii) exa-mine possible changes in social and political calues.

The structure of these studies can be expressed on the basis of five models. These are:-

1. Future as the present with a lead time of one year

2. Future as extrapolation of present -"Scale forecast"

3. Single alternative future - crisis approach

4. Technological future - critical variable method

5. Comprehensive future model - alternate educational future approach.

Two very practical problems arise while considering the educational fututes approach:

i) The intergation of the work on alternative educational futures with that on alternate societal futures,

ii) Organisational setup of the planning process which stands good chances of elaborating and reaching a consensus.

General Assumptions about the Educational System

1. Education is going to be a life long process. The type of school associated with youth will not provide the fare on which one can subsist for all time.

2. Education will not have clearly defined "cut offs" beginning with an entrance examination and ending with a near-dramatic climax of a degree. It will become a continuous process, both as regards its effluxion over time and its embedment in the other functions of life.

3. Education will take on a more informal character as it becomes accessible to more and more individuals. In addition to "learning centres" facilities provided for learning at home, e.g., installation of terminals.

4. To an ever-increasing extent educational system will become dependent on large supporting organisations or supporting systems. Agencies of this kind public or private will need to produce systems of teaching aids information processing and multi-media instructional mater ials.

5. General education and vocational training will be more and more interwomen. Basic schooling will contribute the foundation for re-educability. Skills which help in the assimilation of knowledge will acquire greater importance at the expense of specific pieces of information.

6. Education in the formal schooling sense tends to become more expensive , while annual costs per pupil are rising. Far reaching rationalisations in order to achieve a more efficient utilisation of resources will be needed. These may alter the fundamental aspects of the school as an institution.

In summary, as we study the more remote futures, we must rely increasingly upon our ability to speculate systematically so that we can analyse their content, and "force". Two methods

i) Delphi method provides a frame-work for developing consensus among experts on the time parameters for forecasts. It is important that those speculations are not limited to unidimensional line of change, but in terms of understanding the fundamental trends of contemporary life.

2) Cross impact matrix method, powerful tool for generating a rich mixture of interaction among possible events in the future from which we can produce different scenarios.

The over-riding issue raised by futures perspective is our ability to deal with uncertainty and ambiguity. The greater the number of alternatives we can generate the greater the strain placed upon our capacity to make some choices. The development of complex institutions coupled with the application of sophisticated planning technique represents, in education as elsewhere, an attempt to bring order, predicability and stability to what would otherwise be chaotic state of affair, In modern complex societies, the state takes on the function of formalising and legitimizing the instrumentality of social control so that there is one identifiable set of institutions to which men can appeal for the adjudication of competing interests. Yet, the further one casts into the future, the greater becomes the lack of certainty about parameters and dimension. In other words we have a fundamental dynamic tension between the uncertainty of the remote future and the need for certainty which action and choice impel us to impose upon the present.

The unilenear projection or goal focus is we think an inadequate frame work for considering which among the many input-output pathways, in the social, political, economic and cultural arenas affords possibilities or limits to the future direction education may take.

The view of the educational complex, as an emerging social system whose boundaries or interfaces with the total environment are blurred and changing facilitates a focus on non-formal learning. Who will invent the future education? The answer can only emerge from a recognition of the pluralism in the system. The web of power which controls education extend beyond the traditional institution.

Authority and power in this complex are non-centralised. Its non-centralised character facilitates participation of millions of people for developing the climate for change, for maintenance for regression. Any plan drawn up, any policy formulated, at whatever level or sub unit of the

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system must take into account pluralistic goals.

The futures perspective capability should be protected from demands for particular forecast. Systematic articulation of intentions as well as expectations is necessary, because the need to explicate and define within educational politics goals and values which prevail and come into existence given changes in technology culture and sybolic behaviour.

Two specific needs arise in this context.

1. the need to protect future casters as an administrative entity.

2. to make available to public the products of future casting, alternative educational scenarios.

The exploration of the significance of futures perspective for educational activity may well serve as a powerful way of getting at the fundamental questions of the meaning and purpose of education.

Knowledge Society:

The educational jump from a tradition bound peasant society to modern industrial one is immense. The emerging society is based upon knowledge as the central capita with education and intellectual institutions playing a key role. Movement will also continue toward recognition in institutional forms and practices of the interlocking nature of economics, technological development, education, health and social order. Cybernation will gradually take over, many of the tastes for which men's minds are presently trained. On the whole there will be more years of education per person and near 100 per cent literacy rate.

Schools in the forms we know, will virtually disappear, instead, education will take place via combined system of machines, human assistants located in homes, neighbourhood centres, specialised learning centres, museums and industrial and business location.

A diversity of educational paths will be available, and men will not be judged on the

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basis of a single uniform academic standard. Competitive grading therefore will assume much less significance. Society will provide a diversity of waysin which a person can win the esteem of others. Economic failure or academic failure will not be equated with failure as an individual. Liberation for work, for educative mind forming work, self rewarding even on the lowest physiological level, may become the most salutory contribution of a lifecentred technology.

The "learning society" in addition to offering part-time adult education to every man and woman at every stage of grown-up life, had succeeded in transforming its values in such a way that learning, fulfilment, becoming human, had become its aims and all its institutions were directed to this end. A set of values in turn are based upon a conception of the nature of man, his potentialities and the possibilities for their manifestation. The choice between the two alternative futures is also in a sense a choice between two images of man.

From all of the trends and alternative futures and revolutionary issues there emerge some meta-issues, as keys to the unsolvable macro-problems. These are:-

1. Crisis in human image
2. Crisis in authority
3. Crisis in economic values
4. Crisis in pluralism.

The kind of educational system and educational goals, a society sets up, the way it handles the problem of poverty, the priorities it gives to aesthetic considerations, the extent to which it considers its citizen needs for easy access to communion with nature, the uses of lieusure it fosters, - all these aspects and many more are affected by the image of man held by the society.

To whatever extent the person-centred orientation becomes dominant in the society at large, this will be reflected in its schools. Goals will shift in the direction of placing more emphasis on students becoming effective thinkers and learners, developing enquiry and problem solving skills,

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acquiring social skills, and developing emotional awareness and self identity. Attention will be diverted from achieving behavioural objectives to setting conditions for spontaneous learning, - especially to fostering feelings of safety and trust. Less attention may also be given to grading, credentialling, and otherwise laeblling persons.

Those who will have the tasks of planning and leading, must have a far deeper feel for and for understanding of themselves, as selves and as a part of other persons, otherselves, than they usually do today. Without such educated, sensitized emotional resources, leaders will continue to be too rigid, too defensive too remote, from themselves and thereby from others to have the flexible and bold state of mind that will be needed to cope humanely and imaginatively with plans and turmoil, order and disorder.-----------

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Turning India's Population into a Resource

- A PLANNING MODEL

FOR
EDUCATION MANPOWER AND ECONOMIC DEVELOPMENT

By Dr. Nandini Joshi*

The Bse Document on Futurology suggests that India today has a population of 580 million people and that by the year 2000 A.D. we would be around 960 million people. Of this it is estimated that at least 500 million people would be able bodied citizens who through an imaginative educational programme can be turned into an asset and a resource.

2. This problem can be looked at in numerous ways. In the brief summary of a paper presented here, the question of turning India's growing population into a resource, has been looked at in terms of the "economic dimensions" of the educational process.

3. Here we are concerned with the following major areas which constitute the key combination of the model described in this paper. These are:-

(1) Setting up of the optimal production target.

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*The author is officer on special duty at the Council of Scientific & Industrial Research (CSIR).

Note: This paper is only a brief discussion note for the second meeting of the Technical Sub-group on "Education" to be held on 19.8.1975.

The mathematical details of the "model" described here will be presented later.

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(2) Determining the man-power requirement (sector-wise/occupation-wise).

(3) Determination of priorities among different areas of education.

(4) Resource allocation to and within the educational sector.

(5) Determination of the projections for the year 2000 with respect to our educational priorities.

4. Some characteristics vital to planning for education for the future are integrating educational planning with both manpower planning as well as economic planning, estimation in terms of "what kind" and "how much" of education, choice among the labour-intensities of different production technologies, choice among educational technologies, simultaneous estimation of marginal costs and marginal benefits of different kinds of skilled workers, consideration of heterogeneity of high-level work force, and consideration of cultural or 'consumption' benefits of education along with skills development or 'production' benefits of education. The purpose of this paper is to suggest a comprehensive analytical structure, as a decision-making tool, that can integrate all these characteristics.

5. Education is viewed here as a contributor to preparing the labour force with various occupational skills required for the production of commodities and services. This, of course, is not the only function of education. Other cultural, social and political objectives have their legitimate claim. The purpose of this study is not to rule out other functions of education, but rather to clarify its economic role.

6. The economic role of education is one, but nonetheless an essential one, of the many inputs in the educational planning process. The function of this study is not to prescribe one socially desirable pattern of educational planning but rather to clarify the economic aspects of the educational choice facing the society.

Some Features of the Present Approach to Educational Planning:

7. There is an essential inter-relationship among educational planning, manpower planning and planning for the country's overall economic development. Targets for the various sectors of the economy along with

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the labour-requirements of production technologies, specify the manpower requirements in the different sectors, which in turn, specify 'how many' and 'what kind' of graduates would be required to run the economy. On the other hand the number and kind of available graduates influence the feasibility limits of economy's targets and the choice of production technologies. Designs and decisions regarding educational planning, economic planning and manpower planning, therefore, cannot be separated from each other.

8. Second, while educating and training workers for production purposes an account must be taken of the choices among production-technologies available to the economy. Economic progress involves not only producing more but producing differently. The efficient way in which physical capital and human capital can be combined for production depends on their alternative amounts required by different technologies and their corresponding factor costs. Technological change thus has important implications on educational planning.

9. Third, an important function of educational system in a society is to provide its work force with occupational skills required for productive activity. Material, equipment, power and money resources can be effectively used only if there is manpower capable of processing them into goods and services. The effective development of a country's resources requires a labour force which is educated and trained with various occupational skills. It follows that the educational system must be responsive to the production requirements of the economy. In planning education for productive purposes, it is necessary to give details of 'how much' and 'what kind' of education if plans are to be useful. The creation of new steel works, for example, would be meaningless unless provision is also made for enough number of scientists, engineers, managers, technicians, clerks, etc. to operate it. Besides, many developing economies face simultaneously two persistent and yet seemingly diverse problems - shortages of trained personnel in the modernising sector and educated unemployed. Planning for education must, therefore, also be related to the absorptive capacity of the economy.

10. Fourth, the labour force, especially the high level labour force, is essentially characterised by its heterogeneity. This makes it difficult to talk about education, beyond primary levels, in aggregate terms. Educational planning must take account of different categories of personnel trained in different fields of education.

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11. Fifth, in an analysis of educational planning what is needed is a measure of 'marginal' costs and 'marginal' returns, i.e. what a relatively small addition to the number of students would add in the way of costs and benefits. In order to do this both supply and demand relations should be simultaneously considered.

12. Finally, the cultural and what has come to be known in the literature of economics as consumption benefits of education cannot be ignored. Education not only adds to the productive capacity of the person, but also enriches his mind and renders him a more intellectual and more enjoyable life. Convocation speakers pledge that man does not live by bread alone. Intellectual activity is persuaded for its own sake. Allocation of resources in higher education must also take into account these benefits.

A Comprehensive Planning Model:

13. The model adopted here for educational planning, incorporates the various features mentioned above, and would (i) take a detailed account of the requirements of different occupational skills for different sectors of the economy, (2) indicate the total amount of resources to be allotted to education as well as allocation of these resources among different areas of education, (3) facilitate consistent treatment of benefits and costs of investing resources in various areas of education and indicate how much educating a worker in a particular area is worth to the economy and (4) assist the planners in choosing the best of all available labour technologies as well as, simultaneously, the best of all available educational technologies. It can be shown that the model can be extended to consider further questions regarding education, such as, educating students abroad or importing skilled personnel or foreign aid for education, etc. The mathematical structure of the model described here in the form of a chart, will be submitted to the Group subsequently.

14. The Technical Sub-Group may, in the first instance, examine the relevance and acceptability of such an approach to build an appropriate scenario for the 2000 A.D.

Significant Implications of the Model:

15. A significant implication of the model is that education is introduced in the model as an activity which is optimized; and consequently planning for education is determined endogenously by the system and is optimum in the context of the objectives of the

economy and the constraints of the system. Besides, the cultural or consumption benefits of education are introduced in the objective function which is maximized. In this way, while viewing education as a contributor to the productivity of workers, through the constraints, other cultural, social and political objectives of education, which have legitimate claim for the honour, are also taken into consideration. Further, the use of input-output technique combined with linear programming methods permits the treatment of marginal costs and benefits of choosing various educational technologies. The introduction of educational technologies in the model also facilities considerations of training students abroad and importing foreign know-hows.

16. Another important implication of the model is the formation of the input-output structure of labour force and its use in manpower and education planning. The input-output structure of the labour force illustrates the number of workers with different skills required in different sectors of the economy, each coefficient of the matrix being the number of workers of a particular skill required for a unit output of a particular industry. Each row of this matrix indicates the productivity of that skill in different industries. Each column combined with other non-labour input coefficients for that industry, defines a technology for that industry. If such matrices are available for different countries and from engineering knowledge, comparison between corresponding columns indicate would indicate the intensities with which different can be used in various industries. Such comparisons provide for choice of technologies in various industries which are the most efficient among the feasible ones. This seems to be the most meaningful way in which the shifts of manpower structure required to produce higher rates of economic growth can be considered. Increases in the output per worker occur primarily as a result of changes in production techniques. The model formulated here facilities the analysis of manpower development and educatioh planning by (a) analysing the manpower structure vertically - i.e. considering possibility of substitution between workers and other inputs and of substitution among different categories of workers themselves in a particular sector of the economy and (b) analysing the manpower structure horizontally - i.e. considering the possibility of transforming workers from one sector of the economy to another.

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17. The model allows for a consistent and overall consideration for the entire economy in which all problems of education planning, manpower requiremen and economic development are essentially interrelated. It determines the optimal and the efficient allocation of resources in education in such a way that the welfare of the economy is maximized. The solution of the model yields, after all possible substitutions have been made within the framework of limited resources, simultaneously, the efficient levels of investment in education, requirements for skilled personnel by occupations and by sectors of the economy, efficient methods of teaching and efficient methods of production. The use of the linear programmi methods facilitates the constrained maximization, i.e. the welfare of the economy is maximized allowing for substitutability between labour and capital and among different types of labour, for consideration of cost of education and for feasibility of the functio of the system with regard to the available labour, capi and foreign exchange supplies.

18. A further interesting aspect of the solutions generated by the model is the shadow prices of the investment in education and of the personnel with different occupational skills. As under-developed countries have turned to the task of developing their educational systems it becomes important to know how much an educated worker is worth to the economy; upto what extent the country should invest in training an architect, an engineer, a physician, a manager, and so on; while sending students abroad or while importing foreign skilled personnel how much the country can afford to spend on them; or, whether the country should allot additional resources to education. All these are important questions facing a developing country. The shadow prices of the skilled personnel and of the investment in education give the key to the answers. They serve useful purpose when the prevailing wages of workers are not appropriate for calculations which underlie allocation decisions. The market wage and salary rates may not correctly reflect the current scarcities of personnel with variou occupational skills or their productivity; or the market wage and salary rates may reflect the current scarcities and productivities but not take into account that these will change sharply as a result of development; or finally, the market [illegible] and [illegible]

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may not reflect social values of the skilled personnel where these differ from the sum of individual private values. Differences between prevailing market wage and salary rates and marginal productivity of the skilled personnel are widely spread in rapidly changing economies. They lead to the inefficient allocation of skilled personnel leaving shortages and surpluses and reducing output below what is possible with the same workers efficiently employed. Shadow prices aim at eliminating these discrepancies and represent a set of equilibrium prices associated with the efficient allocation of resources and maximum welfare for the economy. They indicate how far choices between different techniques should be influenced by the existing occupational structure of the labour force. When a particular output can be produced in more than one wahy, there would be substantial advantage in selecting the technique which is best suited to the existing skill structure and to the cost of training these skills, and thus makes fewest demands on scarce resources for utilisation of existing skills and formation of additional skills. The shadow prices of the skilled personnel and of investment in education, which suggest the important policy guidelines, are typical to the model presented here.

19. Developments in linear programming and input-output methods ensure that the model can be made dynamic. This would give a picture of the flow of skilled personnel requirements and educational investment patterns over a period of time. The model could also be made non-linear, which would release rigidities of linearity of the system.

20. Till recently, most of the major works in the literature on the subject have been in the context of the developed countries. However, to point out the contribution of education to economic growth or to earnings of workers is one thing, to decide how much to invest in educational sector and within the educational sector is another. Alternative choices in investment are very genuine for underdeveloped couhtries. In order to investigate investment in education as an alternative choice to investment in another development plan, marginal costs and benefits of education must be considered. Attempts have been made in the literature to determine the marginal productivity of educated workers by calculating the increase in production, or the increase in earnings of the workers, as a result

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of an increase in education of the workers. However, the partial analysis ignores the substitutability of the skilled personnel among different sectors of the economy, as well as the substituatability of skilled personnel for the other factors of production and among themselves. In order to incorporate the marginal productivity of workers (to the national production or to the earnings of the workers) it is the total supply and demand relations that should be considered. The use of the linear programming methods involving input-output structure of labour force permits this.

21. The model yields a considerable amount of information useful to educational planners. The results include optimum level of investment in education, allocation of this investment in different areas of education, optimum educational technologies and labour technologies, and requirements of professio manpower in different occupations and in different sectors of the economy. The model thus provides essential inputs to aid decision-making about education.

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Some Thoughts on Non-Formal Education

by

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1. INTRODUCTION:

There is a growing felling in the country that those who have the greatest need for further education are the least likely to get it in view of socio-economic disparities between different sections of community and the overall poverty of the country. If the aim of growth with social justice is to be realised, the basic need is for providing equality of opportunity for education for all, consistent with democratic goals as enshrined in the constitution. It may be argued that a poor country cannot afford it, but the reverse question is more relevant..."Can we afford not to?"

Non-formal or non-traditional study is more an attitude than a system, which needs to be explored very thoroughly, nurtured in a sustained manner with systematic feedback on its effectiveness in various points of time. It is an attitude that puts performance and competence generation above rigidly following established procedures in this age of change and discontinuity. It is also an attitude that puts the 'student' first and the institutions

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* The views expressed are not necessarily that of the organisation.

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second; concentrates more on the former's need than the latter's convenience; encourages diversity of individual opportunity and de-emphasizes the time or space frames with greater flexibility, mobility and choices in favour of development of competence and skills needed by a developing society.

The importance of the contribution of non-formal education in the development of an individual hardly needs to be emphasised. Illiterate persons in villages, towns and cities especially from the economically weaker sections of society acquire high levels of trade and mechanical skills, and are gainfully employed and quite productive. However, if given the opportunity to upgrade their skills and knowledge they are even able to make minor innovations andcontruibute to the society more effectively. On the job experience of technical workers, technicians and small scale entrepreneurs gives them a practical outlook andinnovative mechanical capabilities. The small scale industries have actually designed, modified and developed new tools without any conscious R&D effort. These could be catalysed if they are mixed with theoretical knowledge. In the case of formally educated persons, formal instruction constitutes only a part of training. Knowledge and understanding acquired through self-study, discussion, reading of popular science literature, hobbies, mechanical skills, job experience etc. contributes significantly to the development of the individuals' personality. Non-formal education thus plays an important role at all stages of development of an individual - in childhood, in student career at school, college or a university, and in employment.

The need for backing up the individuals' efforts towards acquiring new knowledge and understanding, and improving professional skills by suitably designed, flexible and performance oriented part-time non-formal scientific and technological educational programs is obvious. The person working in a village industry, using the most rudimentary technology and inefficient tools, or the farmer using ancient agricultural methods can certainly do with some science and technology education which will help in improving his technology leading to increased production. Likewise, a technician wanting to become a full fledged entrepreneur can use some training in business and management education. Generally, a student will be interested in acquiring knowledge and understanding of topics that are exciting and challenging from his personal viewpoint. The magnitude of effort made by the student in extra-curricular science depends largely on how far the formal education system stimulates the attitude of scientific inquiry and accepting challenges, and also, of course, on the non-formal educational facilities available to him. Persons in employment especially from the economically weaker sections of society and particiularly those who are engaged in the production process will always be willing to acquire scientific and technolcgical knowledge to help them in thier struggle for raising their living standards by raising their skills and therefore production capability. What they need is an opportunity to learn, and this opportunity is not available to them in sufficient measure. This is a striking difference between developing countries and developed countries, with the latter providing sufficient opportunity and ample choice in furthering one's career through non-formal programmes. China, is an effective example of a country with a rising rate of development by providing equality of opportunity through extensive evening course and other non-formal programmes. The benefit to the country through these programmes is emcrmous.

Suitably designed non-formal educational programmes can be of great benefit to all sections of the community. non-formal education can be a means to provide educational opportunities to the deprived sections of society. Through a large number of extension education programmes it can help in continually upgrading thelevel of technology in rural industry and agriculture, ultimately leading to a

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self-sufficient village or district/town economy. It can assist in solving the problems of agriculture and small scale industries through extension programmes and entrepreneurship training programmes, thus furthering the growth of the indigenous S&T base vital to the achievement of technological self-reliance and productive employment orientation. It can be of great assistance in raising individual capabilities and hence the capabilities of the attainment of national objectives.

However, to put things in a proper perspective, the non-traditional education pattern of Rural universities, Adult Education Socienties, Gradhian type schools, colleges and universities oriented towards rural based education combining knowledge and work skills; needs to be fully appreciated and applied extensively in sufficient measure in all parts of the country. This stream goes side by side with the usual urban based eductional practices which have become traditional. The existing examples of non-traditional educational systems are sub-critical in size and need continual fostering andsupport and increasingly brought into the mainstream of education. For example Shantiniketan University; Gujarat Vidyapeeth, Ahmedabad (Rural based education), Ramkrishna Mission Education School in Coimbatore, Indtitute of Gandhian Studies/Indigenous Technology in Varanasi, Adult Literacy Programme in Lucknow, Kasturba Rural Institute of Education, Patiala, etc. have non-traditional programmes. These, however need fresh inputs of sustained R&D along with their extension activity to bring about continual improvements in social organisation and rural technology. Appropriate and indigenous technology needs as much inputs of fresh thinking andsustained research as is being done in other areas. Recently, the state Agricultural Universities have scaled up their Extension and Agricultural Engineering activities to the stage that they are effectively contributing to rural upliftment. The Indian Institute of Management, Bangalore has non-traditional management programmes geared

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towards public sector undertakings, public services and utilities, government policy making. The above examples and not exclusive, but they are indicative of trends which need to be expanded in other parts of the country in view of the size of the country.

2. OBJECTIVES:

A system of non-formal education needs to be designed for the fulfilment of the following objectives:

(1) to supplement formal education during student career, to help the student in his efforts towards acquiring new knowledge, relevant training, imparting of skills and better understanding of science and technology geared towards production and development objectives.

(ii) to provide opportunities for furthering knowledge, skills and training both in breadth as well as in depth (specialised knowledge).

(iii) use of non-formal education as a means for providing equality of opportunity to all segments of society, especially socio-economically depressed and other weaker sections of society.

(iv) use of education as concept for human resources development for furthering national progress in terms of employment generation, self-employment, achieving a social organisation for effective community development, social service programmes, citizen education etc. for furthering and making effective the democratic process.

(v) to improve hardware skills in addition to software...Combination of theory and practice to tackle problems of society and national development. This will improve existing theories as well as strength existing practices through a scientific approach. The results are synergistic in nature.

(vi) to use non-formal education as a means of developing Indian villages and backward districts through

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application of science and technology and management practices consistent with the Indian ethos to achieve socio-economic progress at the desired rates.

(vii) use of non-formal education as a counteracting process to the chaos in formal education which is often dubbed as "brainwashing mechanism" or in practice making a student a "blotting paper". (It is said as a sad commentary of the present time we live in that we are trying to find substitute for learning in education and substitute for courage in administration).

(viii) to educate thinkers and doers, policy makers, decision make scientists and technological professionals, administrators, managers etc. to help project quidelines to our changing society in the age of discontinuity. Some of these may form "Think Tanks" as a resource for the prsent and future of the country.

(ix) use of suitably designed non-formal education systems to help develop the means to achieve the airms and goals enshrined in the Indian Constitution - ways of moulding of the environment suitable for achieving the above objectives through suitable for achieving the above objectives through a mix of programmes geographically distributed.

For the above goals to be achieved it would be necessary to work out in detail, in terms of programmes in time frame, space frame and for specific age/skill/soci economic groups of population and specific performance levels for educational attainments.

The non-formal education system to be evolved shoul be a flexible process, continually reviewed and readjested to be "a model of the real world situation" in terms of understanding the changing environment that affects person and which tells them ways in which they can tackle this changing environment in a positive manner. The non-formal education should be designed as a system and should be used as a continuing education process (rather than the

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one-time learning focus of formal education) wherein a person continually learns, adapts to the environment and modifies the same to the benefit of the society i.e. in the national interest. The detailed working out of a suitable non-formal education system would require an in-depth project to be sponsored to work out various alternatives using different concepts that is, to design suitable non-formal education programmes as a hierarchy of programmes comprising a system with suitable interlinks with formal education at various stages. The following considerations need particular attention:

(1) Classification of levels of skills, areas of knowledge etc. that are presently and in future required in this country as well as specific problems of different regions.

(2) Hierarchy of performance levels, level of knowledge and skills in diverse categories which are required for the nation (in specific time frames) vis-a-vis forma education - a proper "mix" of qualifications and expertise.

(3) Means of achieving the above goals and programme objectivies.

(4) Concepts in Non-formal Education as agents of change with its' interaction with the political process and social organisation.

(5) Design of overall frameworks with interlinks with formal education at different stages and levels.

In terms of education content in various functionary areas or in liberal/education the levels at higher school/ university stages in non-formal education may be the following:

(a) acquaintance level (b) familiarity (c) proficiency (d) mastery and (e) expertise.

3. SOME EXAMPLES OF NON-FORMAL EDUCATIONAL PROGRAMMES IN OTHER COUNTRIES.

1. Council for National Academic Awards (U.K.).

In this system a person in service can upgrade

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his qualifications through part-time courses, self-study and correspondence courses, while doing full time work. Degrees upto doctorate level are granted through this system. The benefit to the country is that it mixes experience with knowledge, operative levels to design, planning and policy levels. Further, as it should be a performance oriented (rather than the usual procedure oriented) educational system, it challenges the individuals and gives a chance for a person to reach the top of one's potential.

2. Open University (U.K.).
   Started with a view to provide opportunities of higher education to persons who for some reason are not able to avail of formal higher education, it provides degree level education through combination of instruction by Television and courespondence courses. Instruction through television has the advantage that lectures can be more carefully planned by employing the best academic talent and can be better than normal classroom lectures as far as practical illustrations are concerned. Besides, the lectures can be reused through video tapes in different parts of the country. In addition to general degree courses, this University provides refresher courses for teachers and other workers and also "post-experience courses" and "conversion courses" for employed persons, to facilitate movement upwards through the occupational structure and horizontal movement between occupations.
3. "Non-school" type Field Education(U.S.A.).
   In slum areas where poverty is rampant, this system provides flexible type of programmes combining learning on the job with new techniques and methods, imparting of relevant knowledge plus liberal education to understa

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the complex environment surrounding a citizen in society, so that he is a useful member. This system uses correspondence courses and evening courses suitably designed and reviewed periodically with academic credit ratings.

4. Chinese Extension Education Programmes.
Making full use of existing facilities in technological institutions and universities "round the clock" and "round the year." These extension programmes have been very successful in rural agriculture and industrialisation, leading to a self-sufficient rural economy. These programmes have also helped in the creation of a strong indigenous S&T infrastructure and technological self-reliance.

5. "World open University" operated from Rapid City, S.Dakota, U.S.A.(Prof.S.T.Li is Director) uses international faculty for correspondence type courses with academic credits course-wise towards well defined postgraduate degree programmes for working graduate and diploma engineers.

6. The "Masters Degree Programme" in Professional Development Programme of University of Wisconsin, Madison is a continuing education programme for graduate engineers. The University of Mexico in Mexico city has non-formal self-study type academic courses for working scientists and engineers with guidance given individually by professors.

7. France has a pioneering "Non-traditional educational pattern" in which about 0.8% GNP is collected for the same to enable workers to upgrade their knowledge and skills.

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4. STUDIES REQUIRED ON NON-FORMAL EDUCATION PROGRAMMES IN INDIA.

In India the Indian Institute of Management(IIM), Bangalore has been concentrating on management of public services and utilities in different sectors e.g. Education, Health, Population Control etc. The IIM is also working on Educational Systems relevant to Indian conditions. Prof N.S. Ramaswamy,Director,IIM and former Director of the National Institute for Training in Industrial Engineering (NITIE),Bombay had run some of these programmes at NITIE, Bombay, relating to the university level. The IIM,Bangalor may be contacted for sponsoring an in-depth study for non-formal education at different levels, especially for engineering colleges and polytechnic type education. The following institutions may be sponsored for making other in-depth studies:

(1) NCERT and the Centre for Educational Planners and Administrators,New Delhi for general science education as well as high school education for drop-outs as well as employed youths.

(2) The Curriculum Research Centre,Allahabad Polytechnic,Prayag.Allahabad for non-formal and formal vocational education systems dealing with technician training and entrepreneurship development. Some very successful programmes have been initiated there.

(3) P.S.G.Polytechnic and Engineering College, Peelamedu,Coimbatore - same as(2) above for South India.

(4) Study on Alternate Technologies in relation to continuing education - (Education Technolog Possibilities choices and concepts, for example: College-of-the Air(Radio,T.V.etc.), Cable TV, Programmed instruction,computers,

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audio-casettes satellite broadcasting, videc-tapes closed circuit T.V.etc.). A technological institute with NCERT and IIM could be sponsored for this study.

5. SUMMARIZING REMARKS.

Non-formal educational programs need to be developed systematically, for which it might be necessary to appoint a Committee to recommend to the government in 4 major items: (a) Objectives and goals (2) Ways and means (3) Students and Curriculum (4) Constitution and Organisation. However, these need to be backed up by in-depth studies and continual review mechanisms.

Non-formal education programs should be geared for the learner of any ages or circumstances, whether for the degree aspirant or the person who finds a sufficient reward in enriching life or upgrading skills through constant, periodic or occassional study. If these programs are well designed and critically reviewed periodically for their actual performance against their stated aims and objectives it can stimulate exciting and high quality educational progress towards national objectives. However, on the other hand, if it is a policy of laissez faire, it may be an unwitting means to a lessening of academic rigor, educational standards and even to charlatamism/gimmickry.

In a country like India where human resources development is of paramount importance, a policy of laissez faire is not one of the options. Choices must be made. Experiments must be tried. A strategy must be shaped. There shculd be an end to the SCHITZOPHRENIA about education. In this regard, to act one must understand and to understand one must enquire. Hence the need for in-depth study concommittant with implementation and action. Sometimes a non-formal program need not be non-traditional. For example, the Open University in U.K. is only a means for getting "external" degrees.

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A high level Committee would be required to explore the need for, the nature of and the potential for non-formal/ non-traditional education in India. Specifically it would be necessary to identify obstacles to those who wan to learn, to study the attitudes to traditional and non-trad tional methods of study. The measurement of progress in non formal programmes; the design for diversified programs mix; and the institutional mechanisms to identify the nature of new kinds of agencies in order to deal with non-formal progr Some non-traditional programmes have been initiated in the country. For example, SITE TV programmes for adult literacy using satellite communication is one example of non-formal education using satellite communications for a large mass of people. However, the programme mix needs to be specifically designed with the involvement of educationists, so that it is relevant to national as well as regional decentralised contexts.

Some possible examples of non-formal educational areas are described in the Appendix, as indicative areas for further thought and action.

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APPENDIX.

Draft for discussion

SOME NON-FORMAL INSTRUCTIONAL PROGRAMMES

By Dr.Aditya Kumar and Dr.J.K.Sridhar Rao.

EDUCATIONAL AREAS: POSSIBLE NON-FORMAL EDUCATIONAL PROGRAMMES IN SPECIFIC AREAS -

Specific non-formal educational programmes can be of several categories. Some of these are:

(a) Programmes for improving rural technology and agriculture, with a view to make a group of villages or a district economically self-sufficient.

(b) Programmes to assist small scale industries in solving their S&T problems.

(c) Programmes for upgrading individual skills e.g. of skilled workers and technicians.

(d) Programmes for advancing extracurricular science in schools, colleges and universities.

(e) Programmes for providing opportunities of education to persons not able to avail of formal instruction.

Various methods of instruction can be used in these educational programmes such as extension services by universities, polytechnics and engineering institutions; correspondence courses, evening courses, sandwich courses, education through radio, closed circuit TV, satellite communication TV etc. In the following, we present some examples of non-formal educational programmes.

1. Extension Service Programmes

Extension service programmes can be used to help in the improvement of rural agriculture, services (health, education etc.) and technology and also for assisting small scale industries in their development.

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(a) Rural Extension Education Programmes

The upgrading of technologies in rural agriculture and industry is badly needed in India. However, trying to jump from most rudimentary technology and tools to the most modern and sophisticated ones in not likely to be of much help, since persons working in village industries and agriculture can neither acquire skills to use the most sophisticated technologies nor do they have the economic capacity to invest in expensive machin It is necessary therefore to develop technologies which require minor and stepwise improvements in working skills, andto educate the village workers to use the new technologies. At the same time, inexpensive improved tools and implements are to be made available. Training for servicing and maintenance of tools and equipment is also important. It is important to continually upgrade the rural technology and methods of production rather than to do it in one step.

For the above purpose it will be useful for each district to have at least one polytechnic relating itself to the problems of agriculture and rural development in the district and one polytechnic working on the problems of the rural industries. These polytechnic may have small scale industries attached to them which will manufacture improved tools and implements designed by the polytechnics and market them in the villages. Alternatively an R&D organisation similar to KVIC and State Khadi andVillage Industries Board for village industries may develop new technology and design new implements and transfer them to the Polytechnics. For this purpose it is desirable to establish and R&D organisation specially for rural industries and agriculture in each state constituting the Indian Union Engineering colleges, rural universities and agricultura universities may also have R&D cells working on these problems. The polytechnics will have extension cells,

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whose function will be to educate villagers of the district on the use of new technologies and equipment. The extension cell may send teams to visit the villages to conduct relevant evening courses, catering to a group of four or five neighbouring villages at a time. In addition to instruction on the use of new technologies and equipment, these courses should contain some elementary basic science instruction and "popular mechanics" type courses related to the understanding of the local environment and resources. Discussions with village workers will help in bringing to focus their specific problems, whose solutions could be attempted by the polytechnics, or the R&D organisation or the engineering college and universities in the region. Suitably designed courses will have to be worked out for these programmes.

The actual demonstration of the application of science and technology in increasing production is likely to be the most important factor in the creation of awareness for S&T among the masses. Having experienced the application of science and technology to its problems, the society will rely more and more on science and will seek out scientific solutions to all its problems.

The coordination of these programmes with the formal school education in villages is very important. As these extension programmes lead to a continual improvement in the production techniques, and hence an improvement in the scientific and economic environme there should be a corresponding change in the school curricula, adjusting them to the changing environment. This will be best achieved by a periodic review of curricula by representatives from the rural development organisations, village industries, schools, polytechni the R&D organisation and the engineering colleges and universities in each particular region. More meaningf

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educational curricula in rural schools will also help to a large extent in the reduction of the alarmingl high percentage of drop outs (a prominent feature of the present practice of rural school ecucation) and make it relevant and directly useful to development.

(b) EXTENSION PROGRAMMES FOR SMALL-SCALE INDUSTRIES

Another important area vital to the development of the economy and the creation of a straong indigenous S&T base is the small scale industries. The small scale industry has the advantage that it needs much lower capital investments and has the potential to generate much larger employment opportunities than large scale industry. In addition it affords a better mobilisation of resources, a better utilisation of the indigenous R&D effort, and an aggressive industri development. At present, however, the small scale industry is not in a position to use R&D because of its low financial capacity.

A major effort is needed to upgrade the status of the small scale industries. Among other measures toward this purpose, extension programmes on a big scale are essential. Engineering institutions, polytechnics and university departments can help the small scale industries by undertaking, for example the following tasks:

(i) Provide access to the competance and facilities to small scale industries for designing and manufacturing of products, lab. scale and pilot plant studies, testing and other technical problems.

(ii) Provide consultancy and other technical services (testing, quality control) to small scale industries.

(iii) Organise R&D activities relating to the problems of small scale industries. This

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will require creating R&D organisations, preferably one in each state, employing a group of scientists, technologists from different disciplines for each R&D organisation.

(iv) Provide technical and management instruction to enterpreneurs, skilled workers and technicians in small scale industries by arranging suitably designed evening courses, part time courses, correspondence courses etc. Maintaining contact with small scale industry through these educational programmes will help in the identification of their specific technical problems, the solution to which can then be attempted.

These extension education programmes if carefully planned and implemented will be of great benefit to the country.

2. SANDWICH COURSE PROGRAMMES

For persons working in industry as skilled workers, technicians and engineers, it is necessary to continually upgrade their knowledge and skills in order to keep pace with the changes in technology and methods of production. Likewise, it is necessary for engineering students to gain some practical experience side by side with their theortical studies, in industry. The sandwich system of training, combining learning with experience, can be very useful here. For engineering (degree or diploma) education it will be useful to design a system in which the student spends some time in industry between periods at the engineering institution. This system has the advantage that the student gains famili familiarity and actual production experience in a modern manufacturing plant and well equipped laboratorie in the industry. These facilities are usually beyond the resources of any teaching institution.

For skilled workers, technicians and engineers working in industry, short sandwich courses at education institutions are very useful to take care of the changing needs of the industry. These courses are particularly needed if theory is a significant part

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of training or if the particular type of training requires extensive use of teaching aids and special facilities existing in educational institutions.

The sandwich system of education needs to be throroughly explored, developed and used in the Indian Context.

3. PROGRAMMES USING INSTRUCTION THROUGH CORRESPONDENCE COURSES, EVENING COURSES, AND BROADCASTING MEDIA

These programmes can be specifically used for providing opportunities of learning to those persons who are not able to avail of formal education for some reason. These may be persons in full time employment, or those who cannot meet the expenses of higher education.

. One of these programmes may be the establishment of an Open University, with apporpriately designed courses to suit Indian conditions. In addition to providing instruction leading to a general degree, the 'Open University' or 'University of the Air' should conduct cour for white collar workers (accounts, law, trades etc.) skilled workers, technicians and engineers etc. to train them in specific skills they may be interested in. For instance a skilled worker may want to educate himself to be a technician. The Open University should offer instruction through correspondence courses leading to diplomas in engineering. For practical training, the Open University can have contact with some other educational institutions whose workshop and laboratory facilities can be used by the students, in the evenings, holidays and summer vacations. Similarly there should be correspondence, evening and part time courses to provide necessary theoretical knowledge and design and supervisio skills to technioians who can be granted engineering degrees on successful competetien of training. Another important programmes would be to provide business, management and marketing education for technicians and engineers who wish to become enterpreneurs. In this

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context it is worth noting that the failure to produce persons capable of setting up their own small scale production, service or consuitancy units has been one of the main weaknesses of engineering education in our country. This needs synthesis of knowledge of Engineering and Business Administration which are treated sparately as water tight compartments in most places. At present, the use of broadcasting media (television) is not available except to a minute fraction of the population. Television is potentially an extremely powerful medium of instruction and the use of TV for educational purposes has to be developed on big scale.

4. PROGRAMMES FOR PROMOTING EXTRACURRICULAR SCIENCE IN SCHOOLS, COLLEGES AND UNIVERSITIES.

Extracurricular scientific activity contributes a great deal in the scientific understanding of the individual at all stages in his student career. Normally the extracurricular science activity is confined to the personal efforts of the individual through discussion with fellow students, reading of popular science literature, etc. There is need to encourage these activities. In addition, regular newspaper articles and radio and television programmes can be effectively used for creating an interest in science among the students. However, these activities have the limitation that they do not provide practical experience to the student. A very useful and interesting way of non-formal education is through "hobby workshops". Schools, colleges and universities should have hobby worshops containing a number of appropriately chosen inexpensive scientific kits on which the students can work during spare time. For example at the elementary school levels the scientific kits can include building blocks, nuts and bolts, gears and pulleys etc. At the secondary school level we may have an electromagnet/call bell kit,

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a hand driven dynamo kit, an inexpensive camera/ microscope/ telescope kit or a mechanical machines kit Similarly at the college level electronics (radio rece and transmitter) photography etc. may be provided. "Playing" with science will greatly stimulate the stud interest in understanding science.

We have given only a few examples of non-forma educational programmes. Many more can be thought of. Developing an extensive non-formal system of education with suitable coordination with formal education and its implementation is an urgent task for catering to the future educational and manpower needs of the country. Some of the other areas in which non-traditi programmes which could potentially be given are the following:-

(a) Agriculture farming, dairying, poultry and animal husbandary.

(b) General Education for Adults and School Drop outs.

(c) Home and Family Life.

(d) Personal Development (understanding government laws, public speaking, physical fitness, etc.).

(e) Public Affairs (citizenship, community problems and organisation, consumer education, environmental studies).

THE EDUCATIONAL CHARTER

by

Shri J.P. Naik*

Education needs to be transformed into a powerful instrument of social change and closely linked to national development. It must also be primarily oriented to the masses of Indian people who still live below the poverty line, create a new selfawareness among them, and by releasing their productive capacities, enable them to participate effectively in nation-building. To achieve these objectives, the following programme of educational reconstruction, which is an indivisible package, must be taken up immediately and implemented on a war-footing:

(1) One-third to one-half of working time in all educational institutions at all stages shall be devoted to active participation in programmes of social service and national development. All teachers and students and other staff of the educational institutions shall participate in such programmes which shall include a reasonable element of manual labour also. Programmes of adult education(including liquidation of illiteracy), non-formal education of the out-of-school youth in the age-group 15-25, and expansion of elementary or pre-school education shall be emphasized in this context; and students shall be encouraged to help junior or weaker students in their studies, such work counting towards their quota of national service.

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* Member - Technical Sub-Group on Education of the NCST Panel on Futurology.

This paper has been taken from Shri J.P. Naik's book "Elementary Education in India: A promise to keep, Allied publishers(1975).

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(2) There is at present an almost exclusive dependence on the formal system of education with its single-point entry, sequential promotions, full-time instructions, and full time professionalised teachers. Such a system is heavily biased in favour of the well-to-do classes and the poor sections either do not drop into it or drop out of it, sooner than later. The system is also extremely costly and wasteful The most urgent reform needed, therefore, is to transform the present educational structure with the introduction of a large non-formal element. At the elementary stage there should be multiple-entry(and special classes) for children who enter at later ages as well as a large programme of part-time education for grown-up children who are required to work in or for their families. Programmes of part-time education and correspondence courses must be liberally expanded at the secondary and university stages, basical to meet the needs of workers for further education, and self-study programmes should be encouraged by throwing open all Board and University examinations to private candidates. Teaching should not be restricted only to professional full-time teachers. Part-time teaching should only be encouraged and all teaching resources in the community should be utilised. Students themselve should be encouraged to participate in teaching as an integral part of their own education and, wherever necessary, remunerated for it in lieu of providing them with scholarships and free studentships.

(3) We spend about Rs.1,350 crores a year at present on education; and yet the system mostly benefits the classes only. This is clear from the fact that 70 per cent of the total population is still illiterate, only 25 per cent of the children in the age-group 6-14 complete primary education, and only 7 per cent of the young persons in the age group 15-25 are in secondary schools and colleges. This distortion of benefits must be immediately corrected and, on grounds of social justice, the masses must get the full benefit of the education system. The following three programmes must, therefore, receive immediate and high priority:

(a) A programme of adult education which is built round creating self-awareness among the people, citizenship, family planning, and upgrading of vocational skill through techniracy, i.e. education in relevant aspects of science and technology. A specific objective if this programme would be to liquidate illiteracy in ten years.

(b) A programme of non-formal education for not less than six hours a week to all out-of-school youth in the age-group 15-25. Its objectives will be the same as those for adult education, with suitable adjustments, and it will specially emphasize participation in games, sports, and recreational activities and involvement of young persons in programmes of national development.

(c) Universalization of elementary education for all children (on a full-time basis where possible and on a part-time basis where necessary) in a period of ten years.

(d) Education ebyond the age of 14 (secondary and higher) cannot be claimed as a matter of right. At present, however, there is an unplanned and haphazard growth of secondary and higher education. Education at these stages also involves considerable subsidies from public funds and its benefits go mostly to the well-to-do classes. In fact, it is the richer classes that are the main beneficiaries of good quality and prestigious institutions at the secondary and university stages. Many of our best educated engineers, doctors, and scientists go abroad and thus create an unhappy brain-drain. Radical policies have, therefore, to be immediately devised at the secondary and university stages to counteract these evils. These may include the following, among others:

(a) To promote social cohesion and national integration, the neighbourhood school concept recommended by the Education Commission should be accepted and implemented.

(b) There should be a rigid control on the establishment of new secondary sbhools, colleges, and universities. There should be strict conditions of recognition/affiliation and these should be rigorously enforced. Except in under-developed areas, no new institutions should be established at the secondary and university stages. To reduce the hidden subsidies in secondary and higher education, adequate fees should be charged and liberal free studentships and scholarships should be available to talented students from poorer families of rural areas. The present elitist

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character of high quality and prestigious institutions should be reduced by reservation of seats for talented students from low-income groups and the weaker sections of the community. Educated persons should not be allowed to leave the country for permanent employment abroad unless they repay the entire money spent on their education.

(c) The highest emphasis should be laid not on mere expansion, but on qualitative improvement.

(d) The university degrees should be delinked from employment; and recruitment policies should be suitably revised to reduce the increasing pressures on university admissions or even on formal schooling.

(e) The highest emphasis should be on vocationalization and the diversion of students into work at various stages. The tendency to continue uninterrupted studies for increasingly longer periods should be discouraged. Programmes of vocationalisation should begin at the higher secondary stage. To the extent employment opportunities exist, job-oriented courses should be designed in higher education also. The wage policies should be suitably readjusted to encourage young persons to go into vocational courses; and all encouragement should be provided for self-employment through the building up of the essential infrastructure.

(5) A radical reconstruction of this type will require not only massive additional expenditure but also considerable redistribution even within the existing expenditure. To be successful, however, educational programmes need, not only funds but sustained hard work, an ethical atmosphere, and cultivation of proper values by the entire academic community. The teachers, students, and educational administrators have an important role to play in this.

(a) The teachers should lay down a code of the highest professional conduct for themselves and enforce it rigorously through professional organisations. It is their responsibility to see that the highest standards are maintained in educational institutions, to identify themselves fully with the welfare of the students committed to their charge, and to maintain an atmosphere of sustained hard work all the year round. They should also assume full responsibility for taking the school closer to the community through programmes of mutual service and support.

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(b) The students should strive to cultivate the basic values of democracy, socialism, and secularism and should fight against all reactionary and obscurrantist forces. They should specially strive fover equality and justice, shown deep sensitivity to the sufferings of the poorer classes, practise austerity, and be ever willing and ready to share suffering with the others. They should be ever vigilant against favouritism and nepotism and set up their own organisations to ensure fairplay in admissions and to prevent unfair practices in examinations. They should also familiarize themselves with the major problems facing the country and should be ever ready to fight for justice and against exploitation and oppression in all walks of life. In all these programmes, however, they should eschew violence which has no place in academic life.

(c) The educational administration has now become extremely weak with an almost infinite capacity to tolerate inefficiency. It is largely oriented to day-to-day maintenance and obsessed with personnel administration(especially with transfers and postings) and budgetary procedures. It provides little educational leadership and is unable even to cope with the problems of rapid expansion, to say nothing of those of qualitative improvement. A radical transformation of this system is, therefore, urgently called for. It will include orientation to development, induction of high quality personnel, large programmes of in-service training, adoption of a four-tier system of planning at the Centre, State, district, and institutional levels, and deep involvement of teachers and students.

Since education is closely linked to life, the radical and egalitarian programme of educational reconstruction outlined above cannot be implemented successfully unless appropriate supporting measures are simultaneously adopted in other spheres also. The most important of these is to make a direct attack on social and economic inequalities which involves a reduction in the level of living of the top 30 percent of the people side by side with provision of minimum needs to the masses of people who live below the poverty line. A national wages-incomes-prices policy should be laid down and the present wage structure should be drastically reorganised on a more egalitarian basis in all walks of life, including education. This alone

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will make it possible to expand and improve education in spite of the severe constraints on resources. The wearing of simple uniforms should be obligatory on all teachers and students in all educational institutions. As a supporting measure, the varieties of cloth produced for domestic use should be reduced to about a dozen and all citizens should be required to wear simple dresses which do not show great disparity. To create the necessary atmosphere for the success of the programme of active participation in social service and national development by all teachers and students, a system should be introduced under which all public offices(as well as offices that receive assistance from public funds) should work only for five days in a week. On the sixth day, all employees of such offices(from the Prime Minister to the lowest chaprasi) should participate actively in programmes of social or national service(involving some manual labour) in their own communities. The Central and State Governments on whom the responsibility for educational reconstruction ultimately rests will have to show the essential political will and provide the needed financial support(the educational expenditure may have to be doubled over the next ten years); and the public will have to cooperate fully and be prepared to sacrifice their other needs in the larger interests of building up the national through this massive educational drive.

TRANSPORTATION

FUTUROLOGY ON TRANSPORTATION

by

Dr. N. S. Srinivasan*

The stimulation of under-developed economies mainly depends, besides other factors, on the development of transport, which exerts great deal of influence on the economy, enhancing productivity, inducing the market, providing stimuli to the economic activities and bringing in remoter areas nearer. "The nation's transportation system is both a major component of the national economy and an important factor in shaping our life style, community development and industrial location patterns."** Viewing from this background of required dominant transport development, it is time to appraise as to where does the transport system in India stand and analyse to find out the lines of development for future so as to make it occupy the proudful position to contribute to the economic and social life of about 960 million people in the year 2000 A.D. The transport system in India has often prove to be a major hurdle in the Nation's march towards unity, progress and prosperity, due to the absence of comprehensive long-range planning. The need for such long-range planning is rightly emphasised by the Committee on Transport Policy and Coordination in the following words, "it is essential to take a fairly long-term view, both because decisions in the field of transport commit resources for the future and are not reversible at short notice and because allocations of traffic have the positive aim of promoting or stimulating action on the part of users and operators which may best subserve the overall interest of economy over a period of years". Since transport programmes involve huge capital investments which act as inputs for the future economic and social activities and also to determine their course, a study in futurology is an essential prerequisite for long-range planning.

The predicted population of the nation is likely to be around 960 million in 2000 A.C. and the vision of the transport future scenario is likely to be three times of the existing passenger traffic and four times of the freight traffic. The transport scenario is expected to register a dominant role of road transport over rail both in passenger and freight traffic.

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*Convenor, Futurology Panel's Technical Sub-Group on "Transportation".

**National Transportation Report, 1972, by U.S. Department of Transportation.

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The future always in its wake brings a structural transformation, the seeds of which are difficult to trace either in the past or even in the present. This fact complicates the task of futurologists and render even known econometric models less dependable for predictions of the distant future. As such, it is absolutely essential to carry out research on the futurology of transportation, so as to meet the challenges facing ahead, in the following lines:

a) Analysis of the existing materials and research designed to provide needed information to assess and understand the nature of transportation process, to define relevant transportation service requi ments and to establish a proper set of realistic goals, objectives, standards and performance criteria for transportation systems today and in future;

b) Motivated research at widening the range of alternative choices of transportation requirements to satisfy the consumers;

c) Research on models and methodologies aimed at improving the techniques available to appraise the consequences of alternative choices so as to take the correct decisions with full knowledge of costs and benefits;

d) Development of engineering ability to design and demonstrate the transportation systems, their performance characteristics so as to effect economy in operation and energy to the nation;

e) Emphasis on the development of scientific research aimed at controlling of pollution and better standards of environmental quality;

f) Provision of meaningful alternatives in the form of better public transportation as compared to private transportation systems; and

g) High degree of emphasis on the provision of better education on the transportation systems which would help to bring out sound transportation specialists for the future.

Decisions in the field of transport involves massive investment expenditure for new facilities and equipments and also have a profound and lasting impact on regional economic development, limiting patterns of future growth and the environmental quality. Hence

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the development of scientific research should be more oriented to result knowledge, insight and technique to make more effective policy decisions. Therefore, it is essential to find out that (i) what are the gaps in the present ability to assess complex transportation problems, (ii) what kind of analytical skills must be developed to bridge these gaps and (iii) what type of research would enhance the ability of policy makers to reach right decisions in the face of uncertainities which prevail in the area.

The problems of transportation transcent national boundries and are universal in their implications. So a common attack on these problems appears to be both natural and desirable. More attention should be paid to human factors, particularly to the needs and requirements of present and potential users.

The provision of transport is a service to the community and adequacy of that service should be judged not only by its engineering efficiency and profitability but also by its impact upon the country and by the extent to which the service meets the level of expectations of the people in terms of comfort, convenience, accessibility, opportunities, frequency and reliability.

Greater emphasis should be placed on the development of analytical techniques to predict social and economic consequences of transport proposals and decisions thereby to reduce the existing uncertainities. More attention should be paid for the development of substitutes for the internal combustion of automotives to overcome the crisis of oil. The systems of transport like pipelines, conveyer etc. which consumes less energy and enables transportation of commodities in bulk at economic advantage are to be developed further.

I. Comments from Prof. G. Ayyaswami, Superintending Engineer (Highways), Head of the Department of Traffic & Urban Engineering, College of Engineering, Guindy, Madras-25.

With reference to your communication, it is suggested that the Report of our Technical Sub-group on "Transportation" to the Main Panel on "Futurology" may perhaps highlight the following:-

1. The existing Transportation situation in our country, its statistics and magnitude, its good and bad points, its deficiencies and drawbacks, its needs and requirements, in both the Urban and Rural Sectors.

2. The visible trends towards which it (our Transportation) is currently moving.

3. An analysis of these current trends to find which of them are specifically healthy and desirable, and which are not so.

4. Formulation of incentives which will encourage the healthy and desirable trends.

5. Introduction of disincentives which will arrest or at least minimise the unhealthy trends.

6. The likely magnitudes of Population, land use, Vehicles, Agricultural activity, Industrial expansion, Economic development, Income level, Gross National Productivity, Tourist attractions and Travel Desires in the Horizon Year 2000 A.D., and the impact these these are going to have on the Transportation media and facilities of that date.

7. The consequences (beneficial and otherwise) of that impact.

8. Methods for combating and getting rid of or at least controlling the harmful consequences.

9. The physical and financial implications of achieving an ideal Transportation situation in 2000 A.D.

and

10. The contributions and role of Transportation in ensuring the continued and steady prosperity of our country by 2000 A.D., in all spheres and walks of life.

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II. Comments from Prof. H.N. Mahabala, Computer Centre, Indian Institute of Technology, Madras-36.

Discussion Points:

1. We are interested in developing a simulation model on IBM 370/155-II system based on the simulation language GPSS. It would be worthwhile establishing a simulation cell under the NCST at IIT Madras which will act as a service bureau for assisting various studies to be taken up by the transportation group. Plotter on 370/155 can provide a facility to obtain graphical outputs for easy analysis.

2. Simulation models are very necessary to examine alternatives and IIT can develop necessary programs as also acquire from elsewhere (outside the country) existing software. One cannot start simulation unless basic structure of the mathematical model is decided and the necessary data to validate the model is available.

3. One of the studies that can be taken up is ascertaining the traffic handling capability of an arterial highway (G.T. Road or Bangalore-Madras road).

4. We should establish the per unit (Km) cost of various modes of transport so that investment for any suggestion can be estimated. This should include the following components:

    1. Cost of road/track etc. per unit distance.
    2. Support investment in service areas, maintenance etc.
    3. Acquisition of land.
    4. Vehicles and its maintenance.

5. Traffic volume handled by typical modes of transport.

6. This meeting should specify a few representative problems that need to be studied. If necessary, we can arrange a workshop at IIT, Madras to stimulate thinking in this direction.

TRANSPORT SCENARIO OF INDIA IN 2000 A.D.

(AN APPROACH TO METHODOLOGY)

by

Shri S.S.Yechury*

and

Prof. Ishwar Prasad**

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Transport scenario of 2000 A.D. is a complex multi-step structure. The outline sketch of a transport system, expected to materialise after 25 years, is a more difficult undertaking in comparison to many other sectors of the economy because of the peculiar nature of this service. Firstly, the demand for transport is a derived demand rather than direct; this implies that the shape and size of transport would be governed largely by the developments occuring in the productive set up and population nucleations in the given space. Consequently estimation of transport demand through single equation relating traffic to output would not be adequate and multistep procedure of relating transport use, land use and changes in productive set up be worked out. Secondly, spatial factors become key variables in transport as transport service is primarily meant to solve the problem of space and time. Thus the assessment of the need for transport services calls for a precise definition of ~~product~~ locations of production, consumption, nature of the product and time dimensions involved in utilisation of these services. Therefore, planning in transport capacity can in practice take place only in terms of planning for particular routes, areas, products or persons. Also, transport is a dynamic phenomenon in the sense the service integrates the production and consumption actively locates which are spatially separated. The transport service influences the location of productive activities and these activities in turn influence the supply of transport service. For all these reasons the shadow of transport events may not be as clear as one would expect from a futuristic study.

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**Jawaharlal Nehru University, New Delhi.

The transport scene in the next 25 years is likely to be different from the present scene in two ways. Firstly, the quantum of transport service provided will be much larger. Secondly, the level of transport technology may be different. How far the future scene will be different from the present one depends on three broad factors:-

1. Transport policy frame
2. Transport technology frame
3. Spatial pattern of the economy.

The transport scenario in 2000A.D. in terms of its quality may not be very different if the transport policy which exists now will remain in future. The degree of difference in transport scene will depend how much transport policy changes from the present. Similarly, the state of technology will determine the nature of transport system in future. Rapid adoption and absorption of technical change by a major transport media will provide a different look to the system than a small technological change. Also, changes in the patterns of industrial location may change the content of transport scene in future.

For any assessment of transport scene in future, there is a common basic approach which may be broken into two distinct phases; a survey phase and a forecasting phase. The survey stage includes an assessment of the transport inventory of the area concerned. It can answer two basic questions and becomes the foundation stone on which the futurology depends. The assessment of transport inventory focusses attention on the existing travel demand and also how this demand is satisfied with the existing transport facilities. The transport facilities and their relationship with the pattern of economic activities,production loci and population nucications would enable an analyst to enter in the forecasting phases. However, past or observed relationships for prognastic purposes have to be suitably modified with judgment.

For an undetstanding of the transport scenario it seems advisable to study three categories of transport in the country.

The firtst of these is "Urban Transport" which is transport within cities and towns. This, in other words, is called the urban transport problem. The basic feature of urban transport problem is that it covers in main the movement of men and materials within a population settlement though the former dominates the scene.

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The second category is the problem of "inter-urban transport". This is an aspect of transport which exists between major settlements of population and production loci. The important dimension of this aspect of transport problem is that this attracts the maximum attention and consumes the major portion of transport investment. Both goods and passenger transport are significant in this category.

The third category of transport problem is "rural transport". This aspect is much more important for a country like India, which is unlike the developed countries where this aspect has received less attention. This problem has long been bypassed by analysists though this should receive equally important attention.

At the forecast stage each of these transport categories in this country has to be studied under various assumptions. For a theoretical understanding of the work involved in presenting a transport scenario, the following four steps seem to be somehow necessary to have a glimpse of the shadow of transport scene at the end of the coming 25 years. A clarity of transport picture will depend on the degree of information generated on these parameters. These steps are enumerated below with brief description:-

1. Spatial Pattern: First is the assumption on spatial pattern of (i) economic activities; and (ii) population settlement. Any transport demand forecast must start with some knowledge of these two basic parameters. The land use model in general is the basic requirement in this category. This begins with the idea that there is a relationship between patterns of land use on the one hand and demand for transport services on the other. In urban transport category it takes the shape of estimating the number of residential locations and their size, extent of migration and the places of work and the distance between work centre and residential colonies and their employment potentials and the rate of transformation of unskilled labour to skilled labour. In inter-urban transport forecast it takes the shape of industrial and commercial centres on the one hand and their interaction. In the rural transport, so far this country is concerned, the estimation has to be made of the agricultural surpluses and the average -distances of mandis from the rural settlement and the area of influence of urban settlements and pattern of employment in urban areas.

2. Traffic Generation:

The information gathered at the first step of needs to be converted into physical estimates of transport requirements. It is desirous that this stage distinction will

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have to be made between passenger transport and goods transport. However, the unit of measurement is still a problem. The quick answer to this is passenger Kms and tonne Kms. The forecasting exercise will take into account the originating and passenger and goods and their average length of journey. This exercise has to be carried out for each of the three categories. For urban transport it is the different areas of the city which has to be taken into consideration. In terms of inter-urban transport each region of the country has to be taken into framework. And similarly for rural transport each region has to be assessed.

3. Regional Distribution.

Given the volume of trips generated in and destined to each region, zonal interchange models provide a description of traffic between areas. The general technique adopted for this study is the gravity model or intervening opportunity model for the linear programming model.

4. Choice of Transport Techniques:

This is the most crucial aspect of any transport scenario. The choice of transport technique between two points of place, given the volume of demand, has to depend both on the demand side of traffic generation and supply side of the availability of transport facilities. The demand side takes into consideration the basic economic and service characteristics of transport choice which may differ for different transport categories and even within the same category the choices have various alternatives. For instance, in the category of urban transport the choice ranges among rapid rail transport system on the one hand (that also of several categories like over-ground, ground or under-ground types) and automobiles on the other. On the automobile category it can range from private and publiccars to private and public auto rickshaws. Similarly, in the inter-urban transport the broad choice is between roads and railways or a combination of both. In the rural transport the analysis has to be on the assessment of bullock carts which is the main carrier of goods traffic in the rural areas. The question remains how much impact mechanised road transport will have on the rural transport so that the displacement factor between bullock carts and trucks/buses can be worked out.

Having an idea of these steps in mind an analyst can work out a macro view of the transport scenario for any future. For a quick assessment of the future shape of transport in India within the limitation of data in this area a further outline can be presented. If adequate amount of information can be generated and/enough resources are available to work upon each of the foregoing steps can be studied in detail. Otherwise a somewhat easier statistical techniques can be adopted to arrive at the volume of transport expected after 25 years. Therefore, a summary of the estimation techniques and procedures has been presented in the following paragraphs separately for (1) urban transport (ii) inter-urban transport and (iii) rural transport.

1. Urban Transport.

Urban areas are characterised by the high level of traffic because of the settlement pattern, level of income and columns of activities which are both high. A general methodology for assessing demand for urban transport is to begin with an understanding of the future pattern of land-use and subsequently coming down to the estimation of the volume of traffic and the number of vehicles. The vehicles would compose of trains, trucks, buses, cars and motorcycles. There would be three type of commuters(1) using mass transit trains(2) using buses and (3) those who use private cars and scooters. These impose particular load on the urban transport system because they all travel in much the same time which is called the peak period. Peak hour traffic exceeds the non-peak level by a considerable margin. That is why, urban transport problem is synonymous with the traffic velocity arising during peak hours.

In India there are four major cities of Bombay, Calcutta, Madras and Delhi which have serious problems of transport and for which feasibility studies for the metropolitan rail projects are under study(to assess the future volume of traffic and ways and means to handle them). In addition five more cities viz., Ahmedabad, Bangalore, Hyderabad, Kanpur and Poona may also have mass transit facilities by 2000 A.D.

The demand for suburban passenger traffic would depend on the size of population, income levels of the people and land use pattern. The aggregate level of traffic in cities can be estimated on two other alternative methods viz.(a)trend method; and (b) population method. The trend method is expected to be the less accurate than the population method. The latter takes into account the expected total population in 2000 A.D. in big cities, a factor which is originating the passenger traffic, and the estimated average load. These would give the total urban passenger Km. and Ton Kms. which again can be worked out in terms of transport units needed.

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The technological choice can be worked out for (a) mass transit system(b) total number of buses, (c) number of cars and (d) total number of motor cycles. However, for all these a lot of judgement will have to be exercised.

2. Inter-Urban Transport

This group of transport is important for two reasons. Firstly, the volume of traffic, both in terms of passenger and goods, is the heaviest in the transport sector as a whole and secondly, the maximum amount of investment and consequently the technological changes have been committed in the past in this sub-sector. In future also this group has to remain very important because this is the link between the rural economy on the one hand and urban on the other. With expanding industrial activities this aspect of transport, is more crucial.

For our convenience of forecasting this group of transport can be sub-divided in two parts; goods transport and passenger transport.

2.1 Goods Transport.

Inter-urban freight traffic is the one element in transport demand which is relatively easier to isolate and forecast with an assumed growth rate of the economy of that region. This is because the volume of freight traffic is closely related to the levels of economic activity. However, there is one serious assumption about its forecast. A static relationship will have to be assumed in the sense that changes in the volume of production and the location of industries will affect the volume, size and type of freight service rather than the other way round. Furthermore only two modes of transport would be studied because they carry the maximum. They are rail and road. Other modes of transport like waterways, pipeline and airways are insignificant in terms of volume of traffic.

The forecast of freight demand can be made by a number of statistical methods. (1) The trend method can be applied to see what results it can offer. (ii) A statistical relationship of any time series in the recent past can be established between output and transport which can give a fair basis for forecasting the likely growth in the total demand for inter-urban transport of goods. (iii) An income elasticity approach can also be applied for such a forecast. (iv) Transport coefficient of major commodities can also be worked out for projecting freight transport.

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The division of traffic between railways and roads is extremely difficult. This has to depend on what is the pricing policy and licensing policy of government, the prices of oil and the proportion of raw material to finished goods to be moved in the economy as a whole. Therefore, some judgement will have to be exercised. The technological choice and the technical change for the railways can be specified if the regional distribution of traffic can be worked out on the basis of future 1 location of industries. Also the impact of containerisation will have to be substantial at 2000 A.D. on making choices alternative transport modes.

Passenger Transport.

This part is much more difficult to forecast than goods transport. The volume of population together with the levels of income and personal choice will determine the total amount of passenger demand in the country. Higher levels of income demand faster speeds. Faster speeds call for individual transports and faster vehicles. It also depends on the transport facilities people are offered. Variableslike changes in prices of transport compared with prices of other consumer products matter. The relative levels of transport pirices would be affected, not only by technical changes but also by Govt. action, such as changes in taxation.

There are several techniques to estimate future inter-urban passenger transport demand. The gravity model has typically been the starting point for inter-city passenger demand, having with a long history and a continuing usefulness in forecasting trip generation and zonal inter-change. However, the type of aggregate answer we are trying to arrive at, these are following methods which can be applied for estimation and can be checked with each other for an acceptance.

These methods are:

1. Trend method based on the past time series volumes of rail and road passenger traffic.

2. Income elasticity approach which can be worked out at several income levels.

The technological choice for mode selection can be considered to be extremely restricted for two reasons; first, because it is difficult to assume a big jump in the per capital income of the people and second, because of the relatively larger distances to be covered while the country as a whole is taken into consideration.

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3. Rural Transport.

The third category of transport is rural transport. This is an area which is much neglected by the analysts. of this country in the past partly because the framework of analysis is founded in the western theories developed in world. However, this should be the most important area of transport analysis both because the majority of Indian people live in rural areas and also because the success and failure in rural India determines the economic health of the country. It is therefore important that any futurology must concentrate its attention on rural transport.

An assessment of the future net work of rural transport in 2000 A.D. has to assume a number of parameters before it enters in the assessment part of exercise.

Firstly, it can be assumed that every village will be connected either by pucca road or kuccha road, by the end of the century. This is not completely out of line since the 20 years road building programme has already been achieved before the end of 1981.

Secondly, for the transport scenario, the main concentration will be, on the movement of goods rather than on the movement of passengers. This is because the rural economy will be dominated by agricultural activities and the bulk of movement would be from farm to mandi. The passenger transport is less significant and difficult to quantify because of walking and cycling which contributes most of the passenger kilometers.

And thirdly, it is assumed that bullock cart will be the main carrier in rural areas in spite of the two significant developments affecting this hypothesis, first, the greater use of tractor in the rural areas would substitute bullock carts and second that there would be greater penetration of trucks and buses in the rural areas because of the improved road network in future.

Given these hypothesis the assessment of transport demand in the rural areas have to depend on two factors, (i) the pattern of settlement and its population size. and (ii) the volume of agricultural produce and the consequential surpluses to be disposed off to Mandis.
The population figures can be had from the population projection which for our purpose, can be assumed that each, existing settlement will expand in the size of populations obtaining rather than new ones coming up anywhere. The agricultural surpluses will have to be worked out on the basis/projected agricultural produce

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and the size population of that region, the volume of surplus can be worked out. The average lead between the farm and Mandis will also have to be established. Thus total tonne Km. or cart Km can be worked out with ease and correctness.

The technological choice in the rural areas, as defined earlier in this section, would be primarily bullock cart based. Total number of bullock carts can be worked out whereas some estimates can be made about the use of tractor and trucks.

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A note on points submitted by Shri S.S.Yochury, Controller of Transport, Ministry of Health and Family Planning to the Group on Futurology on 4.2.1975 (First meeting at NCST).

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The objectives of the Futurology Sub-Group on Transport, as I understand, are:-

1. to determine the type of the technical development needed in the transport field;

2. The re-distribution of transport between the various modes viz., rail, road, water and air and pipe-line, etc..

3. Regional redistribution of the existing Transport investments;

4. Re-location of traffic gnerating centres such as factories and work places and domestic areas; and

5. The economic re-considerations in view of the real costs to the nation instead of actual costs in rupees; etc. etc.

I wish to put down my views on the technical aspects regarding the development of a transport system in 2000 A.D. preparation of a transport scenarie for 2000 A.D. I am aware that this transport system should take into account the Demographic, economic and resource locational factor.

1. Transport Policy

I feel by and large road transport should beused for shorter of men and materials while the rail or water transport should be resorted for bulk and longer haulage.

2. Strategy

(a) An effective practice of this strategy involves the development of commensurate material handling equipment, This may involve the designing of low dost containerisation.

(b) The group felt that the emergence or establishment of a Transport Authority for purposes of coordination as well as for the elimination of the unhealthy competition between different modes of tranport.

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(c) While there may be point in developing a rail syst with a larger capital outlay with a long pay-back period, ther still seems to be an equally strong case for developing more roads and investing more money for flanking the waterways at public cost, to get a homogeneous and optimum mix of various modes of transport.

(d) In arriving at optimum mix of transport investment for different modes, the continuing inflation should be kept i view for each mode.

(e) Easter or slower transport

Technically speaking, SPEED COSTS MONEY. It is an important question for examination whether we need the existin speeds? If not, can we lower or increase them to the nation's advantage?

3. Life Style of Nations

From another angle, namely, the life style of the Nati especially that of India, it is such, that a large section can accept lower speeds. Even if we decide to accept the present trend of a "mad-race-for-speed" which has become synonymous with civilisation, it may be quite possible for India to accep two speeds of travel one for rural transport and the other for urban areas. If we accept lower speeds, we should re-design the vehicles with smaller capacities, and alternative or multiple capabilities. Even in such situations, multi-purpose unit-vehicles should be made to carry larger loads, on poorer road surfaces by a thoughtful design. But the deployment of multiple use-slow moving media of transport in rural areas should be treated as a relative concept. If the transport is meant for long haulage of perishable goods such as milk or meat, specifically designed high speed vehciles may have to be used. However, if it is a shorter, non-perishavle haulage food grains or passengers, low speed units may be used.

4. Rural Urban and Inter-urban transport

(a) If the rural folk can accept a motorised-cum-pedalling version of vehicles, where human energy subsidises petroleum energy, such as "MORICKS" patented by the Ministry of Health and Family Planning, a large number of buses, cars and trucks can be released from the existing rural stock of vehicles for urban or inter-urban applications.

(b) Then it may also be possible to reduce the cost of construction and maintenance of roads by prefering poorer type-surfaces with less load-carrying capacity per square inch

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5. Bullock Cart Era

(a) While one might say that the "Bullock-cart age" is over probably there is a case for it to exist, though scope for this primitive type of transport and its application may be limited.

(b) It may give the added advantage of providing the "Gobar-Gas Plants" with regional variations based on size and development of bulls, availability of fodder, types of terrain, etc. which can produce additional energy production for transport or otherwise. It is just not possible to design bullock carts with varying wheel sizes to suite the differing horse power of bulls used in various terrains and the regional requirements.

(c) In time of energy crisis, this low investment, multi-purpose-cheap-transport seems to play a greater role with better regional distribution in a vast country as ours.

6. Private vs. Pubic Transport

Nationalisation of passenger and goods transport seem to be order of the day. Even here instead of copying the vehicl designs from other developed and affluent nations it may be mor desirable to design two distinct types of indigenous vehicles; one with an emphasis on heavy-haulage at low fuel-consumption and low total cost, and the other light haulage with faster speeds at reasonable economical rates for perishables, emergenc supplies etc. and to allow the private and the public sectors to coexist.

7. Investment Availability and its Consqeuences

Since the best of ideas and projects in developing nations are always likely to be bogged down, or delayed, for lack of investmentable resources, it may be necessary to set up new and different design criteria.

For example(1) let us take an authomobile. The chasis lasts 2 to 3 lakh miles. Body lasts 1 to 2 lakh miles. Engin 0.5 lakh miles, gearbox and differential last one lakh miles, the tyres last 0.2 lakh miles, upholestry lasts 0.7 to 0.8 lakh miles, Battery lasts 0.4 lakh miles and what not? Is it really not possible to design a vehicle with all parts lasting, say, 0.5 lakh miles or its multiples? I think it is possible. If so the nation can plan its road transport investments and road transport policies better.

(2) Similarly in the authomobiles world, it is said that economic production needs a minimum of 1.2 lakh car units per annum, because the producing machinery cannot pay for itse below that level. For the 33 different makes of vehicles viz.(3 cars, 2 jeeps, 4 passenger buses, 8 trucks, 3 three-wheelers, 2 scooters and 6 motor-cycles and 5 mopeds in this country, we seem to be having more than a dozen capacity of engines. We also use inumerable sizes and makes of

generators, starters, carburettors, ignition system, springs shock absorbers, pistons rings con-rods, camshafts, bearings and what not. We do not need this much variety.

8. Standardisation and Technical Development

Is it not possible to design the transport industry at national level by standardisation of vehicles for carrying pay loads of say 200 Kg., 500 kg., 1000 kg.,2,500 kg., 5000 kg and 10,000 kg, pay loads? Can we not make all the ancillaries standardised? Given an opportunity collectively to all the Research and Development Engineers engaged in India by the automobile and ancillary industry, their loyality to the royality of foreign makes will disappear overnight. I am sure that variety reduction and standardisation was not exploited because of lack of a well thought out transport policy in the country. Otherwise, what was done under Hitler Regime in Auto Industry in Germany or in Japan after II World War or American Auto Industry 3 to 4 decades ago forming conglomorations is no impossible for India to be achieved. Technical Development strategy seems to be the answer for national transport development.

9. Research and Development:

(a) With the present fuel crisis and forceable future prospec of finding oil less than the demand in the country, there seem to be a case for either developing alternate fuels or carrying out experiments such as I.K.Bharati's operation of vehicles with petrol and water mix. However ridiculous it may sound, such experiments have to be carried out so that one can find ultimately either an alternate fuel or, in the bargain a bette method of fuel consumption and fuel conservancy.

(b) Coal vs. Petroleum

India has more coal deposits than petroleum, coal gas-plants as used in the second World War period in India may become an economical proposition in the present context., of availability of low quality coal in abundance and less availability of petroleum.

10. Common Gauge for Railways

Taling of railways and their gauges it is said that meter-gauge seems to be a more economical system than broad-gauge or narrow of gague, because of its balance of operation, if it is really so, is it not more appropriate to think of a dual gauge bogies with common coaches and a future standardisation of coal fired meter-gauge railways for the nation?

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11. Development Strategy

Regarding the urban transportation, while there is an imminent need for reduction in the size of cities which is impossible I feel that at least starting of self-contained fully equipped localities seems to be an urgent need. We may, or may not be able to get away from the mass transportation systems for the central business district, but, if the urbanisation is deliberately directed to develop fully equipped localities. We may do away with heavy "DOWN-TOWN TRANSPORT NEEDS" as was done in Europe and America to a Small extent and provide a most confortable conveyance for the passenger from origination to destination without any transhipments. In the Central Business District Area a compromise has to be made by reducing the importance of single direct journeys by introducing directional travel, nodal points of transhipment, larger vehicles with small boarding and alighting times and semi-sitting instead of full sitting vehicles for short-distanc travel of 10 miles or less.

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Discussion on the paper by S.G. Yechury & Iswar Prasad

by

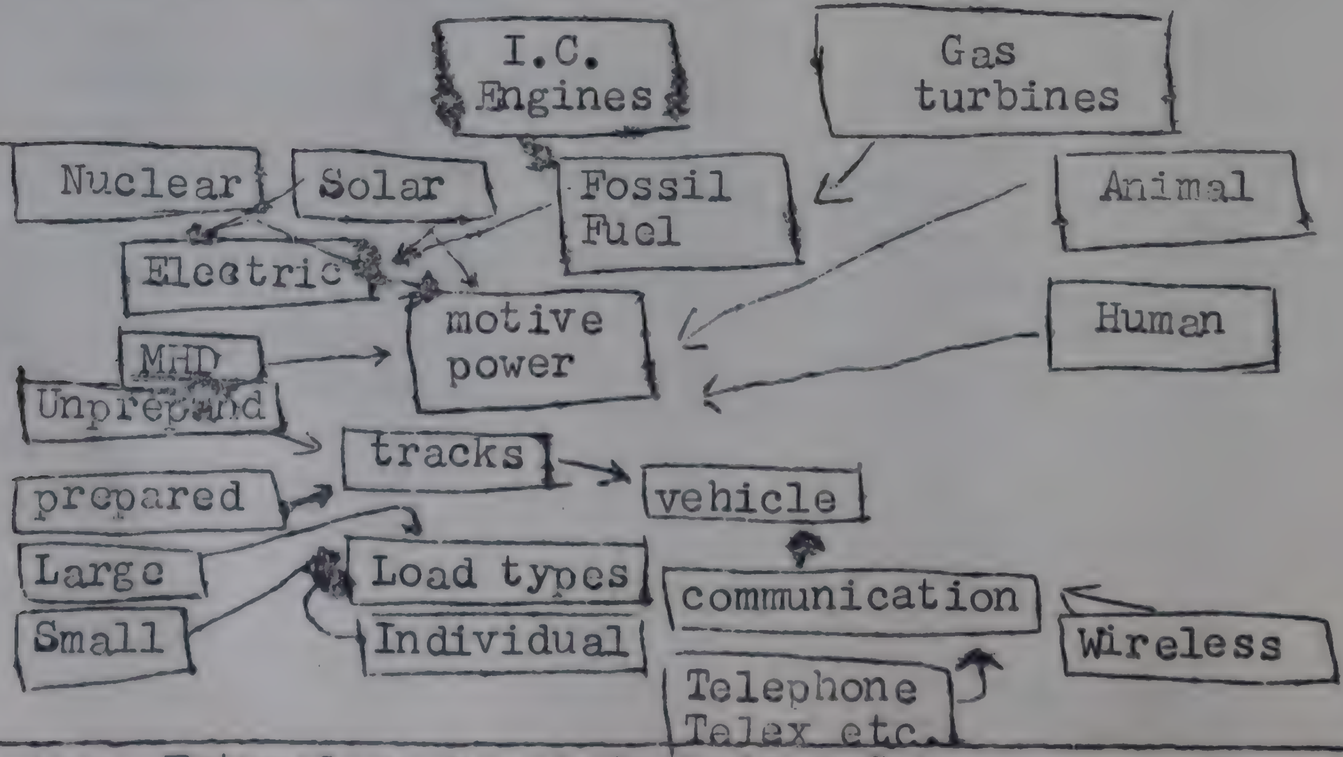
P.N. Murthy*
Prof. and Head, Department of Aero-Engineering,
I.I.T., Kanpur.

The authors state rightly that demand for transport is a derived demand and not a direct one. However, it has an important influence on the life style of a community. In fact there are many instances in history where availability of a new transport vehicle-type has influenced substantially the growth of a nation. Therefore a conscious search must be on for a new vehicle-type.

2. Any assessment of transport scene in future requires, as pointed out by the authors, a thorough survey of existing transport inventory and capability to forecast the future needs. If this means only extrapolations from the present, I am afraid, it will not meet the needs of the future. An independent method of visualising the vehicle-types fitting into the future community scene will have to be devised. The design engineering techniques may be of some help here.

3. The NCST base paper on futurology describes the scenario in 2000 AD. It predicts and visualises a community faced with glaring shortages in every sector of economy and large populations struggling for survival. The community will be straining every nerve to optimise the available resources by proper generation, acquisition and distribution. All these three imply instant communications between men and 'aerodynamics' mobility of materials. What can be the vehicle types that can achieve this?

A simple system chain for a vehicle will be :


I.C. Engines
Gas turbines
Nuclear
Solar
Fossil Fuel
Animal
Electric
motive power
Human
MHD
Unprepared
tracks
prepared
vehicle
Large
Load types
communication
Wireless
Small
Individual
Telephone Telex etc.

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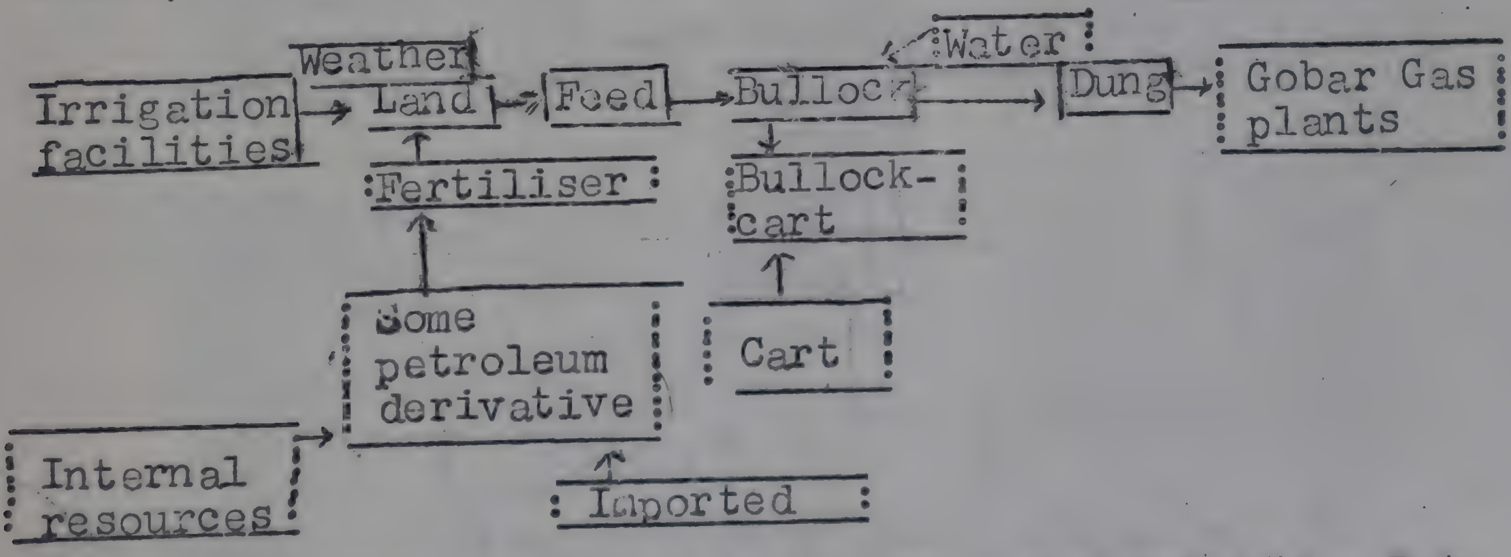
* Member, Futurology Panel Technical Sub-group on Transportation.

One can see that several alternative concepts are possible. Each block in the chain has a significance. Combinations of relevant blocks will give rise to alternate solutions and concepts. We are of course familiar with two concepts at present : (i) Animal drawn carts plying on unprepared tracks and (ii) trucks, cars and buses powered by petrol and diesal engines plying on prepared roads, pulling heavy and light loads. We can easily extrapolate their relvance in the third milenium before considering other concepts.

4. It is projected that even in 2000 A.D., India will have a predominantly rural character. However, the land use pattern may change somewhat. In place of single villages, a complex of villages will constitute a unit. This may be known as a greater village oramega-village or a rural complex with common interests, services and interactions. Cities will acquire characteristics of a megalapolis.

5. In view of the severe cement, oil and steel shortages predicted, it may not be possible to connect the villages with pucca roads. However, as stated in the paper, one can safely expect at least kutcha roads to connect the various points in a rural complex. Then, will be bullock cart suitably modified, retain its pre-eminance as the basic means of transport?

6. Once again a simple system chain can be drawn as shown below, to examine this question.



The system chain may look rather far fetched. But this is the reality. Any failure in the chain will upset the whole system operation. An important block in the chain is the 'Feed' block. It is now being realised that a large amount of food grown in the world is being used up by the Cattle. Speculation is that it may not be possible to allow this in future in spite of the humanistic considerations, due to the acute shortage of food grains. Further, in producing the feed, a number of blocks are involved. A drought, an ill developed irrigation facility,

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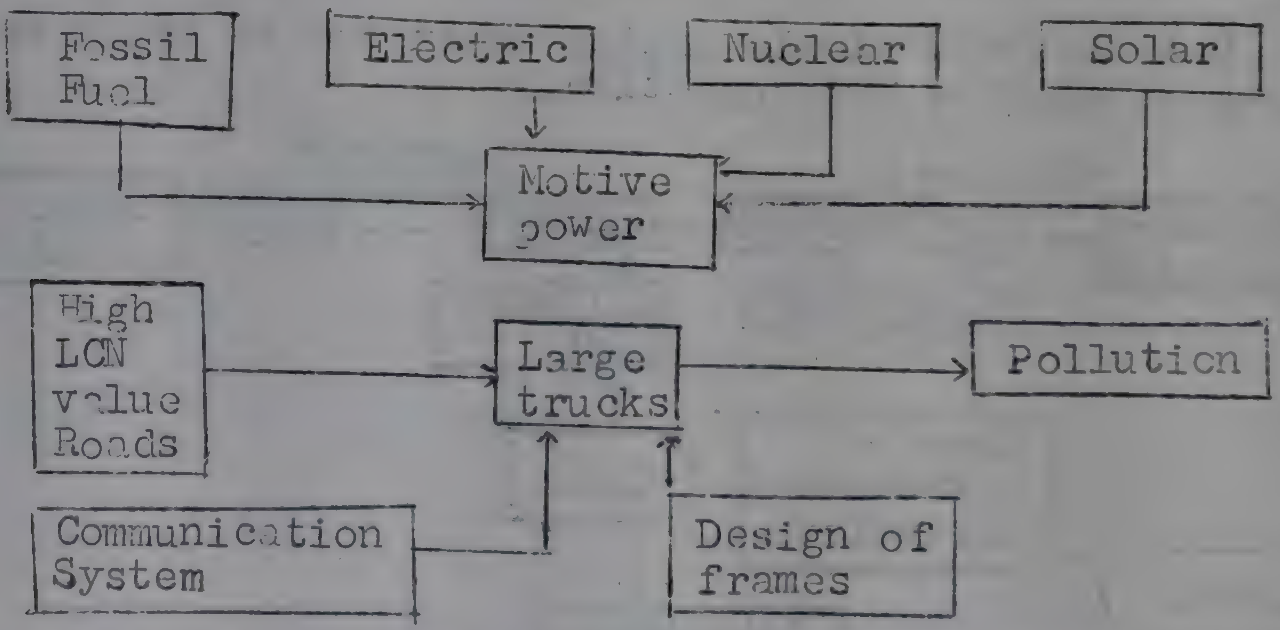
or a strike in a fertiliser factory can completely immobilise the bullock cart system. Any claim of this type will disturb the fragile balance of the economic system causing distress to millions of lives. To avoid this, an important specification will be to insulate the vehicle type from remotely generated disturbances in its necessary supply lines.

Thus one can appreciate that bullock cart concept, contrary to what the authors say, cannot be extrapolated as a possible vehicle type unless the above considerations are ignored.

7. Another innovative concept that is possible is a vehicle powered by a solar engine running on unprepared tracks designed to carry light or large loads depending on the technological needs and advances. This meets several specifications. The source of energy is entirely local and almost continuous and generating station from which power can be drawn to run the city and used to run a motor. The vehicle body will perhaps be acting as a solar collector. This kind of vehicle can change the pace of growth in the rural complex.

8. One can similarly apply the design engineering technique to assess the possibilities of a large truck as a major transport vehicle. The system chain can be shown.



It can be seen that an important factor enters into the system : (i.e. pollution. The biosphere in 2000 A.D. will be thermally so heavily loaded that it may not be able to sustain more inputs. Other forms of motive power than the present engines will, therefore, have to be devised. So an altogether different consideration limits the evolutive capability of the present design.

9. These and such other factors have, therefore, to go into the technological forecasting. It is suggested that independent methodology like design engineering should be used to determine the vehicle-types of the future to make the transport scenario in the third millenium meaningful.

Comments by Shri N. Appukuttan, Director, Department of Science & Technology, New Delhi, on the paper "Transport Scenario of India in 2000 AD."

The paper deals broadly with the methods of forecasting future requirements of transportation. Different forecasting methods like traffic surveys and mathematical models are available but as correctly pointed out in the paper, experience and good judgement are necessary in proper forecasting to avoid over-planning or under-planning.

2. Today, in our country, the main problem of transport is the gross inadequacy of various modes of transport, which has resulted in heavy overcrowding in the case of passenger traffic and inordinate delays on the freight services. This is mainly a problem of inadequate resources than of forecasting defficiencies. Looking at the present transport situation, it is obvious that the priority for future transport planning needs to be given in consolidating existing transport facilities and then to strengthen them, in order to make travel more comfortable and to make transport services for passengers and freight more readily available. This would, in turn, mean planning for allocation of more resources. In our country, the present modes of transport may continue for the next 25 years as it is unlikely to find enough resources for large scale sophistication or altogether new modes.

3. As far as the traffic forecasting is concerned, the normal practice is to follow more than one of the different models, compare the results and then make projections for the future based on the model study, making use of past experience and judgement. Future projections of transport requirements may be available with Ministries of Railways and Transport and various metropolitan planning authorities which could be made use of. With the large gap between requirements and availability of transport as existing today, use of very refined theoretical models for future forecasting may not serve much purpose and augmenting the present facilities to the extent permitted by the available resources in order to lessen the gap will be more important.

4. In planning for future transport, emphasis needs to be given on mass transport systems which will

bring more benefits to larger part of the community. Private transport like cars, taxies, etc. which make use of disproportionately large amount of the infrastructure and benefit relatively few people needs to be discouraged On the mass transport side, railways come first, which can carry large volumes of traffic at faster speeds resulting in less per capita investment. Next to this will be the bus transport.

5. In planning for the future traffic requirements of different sectors, the following aspects may be considered:-

(a) Urban or Intra-city Transport:

As mentioned above, priority needs to be given to mass transport systems. But the main problem with urban mass transport planning is that such systems are never financially viable and large scale governmental support in initial investment and recurring costs is necessary. This is the main reason for inadequate mass transport facilities in all our cities. Mass transport railway system will be the quickest and cheapest as far as per capita cost is concerned where the volume of traffic is large. Surface railway will be the cheapest, then comes elevated tracks and lastly underground railway In cities which are not yet congested, it will be desirab to reserve space for surface tracks. Underground lines which are the costliest form of the rail transport, shoul be resorted to only in congested cities like Bombay, Calcutta, etc. where surface railway is just not possible

To make bus transport system more effective as a rapid transit system, the feasibility of prohibiting private transport like cars and taxies within city-centre should be examined, at least in busy cities. Use of electric traction for buses either with overhead conductors or in the form of battery operated buses need to be explored to reduce pollution problems in cities.

(b) Inter-Urban or Inter-City Transport:

This form of transport is generally self-supporting and there should be no difficulty in strengthening the inter-city transport. The cheapest form here is also rail transport. The present speeds are very low and it is necessary to plan for speeds of 160 to 200 km.p.h. Strengthening of tracks and rolling stock and powerful locomotives are necessary for increasing the speeds. Electrification of inter-city tracks will be needed in view of the oil crisis. In the future, air competition will have to be considered in planning for inter-city passenger traffic particularly in respect of upper classes. On the freight traffic side, trains of heavier loads and increasing the speeds would be necessary for carrying additional traffic and reducing delay in transit.

(c) Rural Transport

Probably bus transport may continue to remain economical over rail transport for rural areas. The conditions of rural roads are generally deplorable today and the immediate need appears to be of improvin the roads. This will facilitate bus services to operat in more villages and as such will make it possible to switch over from bullock carts to trucks or tractors for freight traffic. Rail services from villages to cities are also now inadequate. Services are infrequen and slow. Rail services can be improved by providing E.M.U. (Electric Multiple Unit) Services where electrification is cheap or D.M.U. (Diesel Multiple Unit) services. But the economies will have to be studied.

6. Coordination between different modes of transpor

Today there is unhealthy competition in certai areas between different modes of transport like air, rail and road transport. In the national interest it is necessary to coordinate different modes to make eac complementary to the others.

7. In summing up:-

(a) In view of large gap existing between the requirements and availability of transport today, priority in future planning should be to make available more resources for strengthening the existing transport. Forecasts available with various Ministries and metropolitan planning authorities can b made use of and more refined methods may not serve muc purpose till the present gap can be considerably reduc

(b) Priority has to be given in planning for mass transport systems which will bring larger benefits to the community.

(c) Proper coordination between different mod of transport is necessary to avoid unhealthy competiti which may result in wasting of scarce resources.

TRANSPORTATION SCENARIO IN 2000 A.D. - TECHNOLOGIES AND POLICIES.

1. Introduction

The magnitude of the visualised transport problem of the futuristic scenario at 2000 A.D. was considered in the last meeting. Before considering the warranted frontal attack to the problems, it is proper and not out of place, to say, that we have to take stock inventory of the different infrastructure and super structure facilities available. It will be only fitting and not unwise, to concentrate this meeting to study frankly without prejudice or bias the defects and drawbacks in the technologies and methodologies, models and systems, principles and policies and, coordination and integration of the different sub-sectors of transport and the National Transportation Sector as a whole.

2. Problems of forecast

Turning deep into the various problems, the few problems of importance are listed below. As regards to the forecast technology it will be better to know the gap between anticipation and materialisation in the targets of different modes and to find out what were the deficiencies in the anticipative technology and the factors responsible for it. Similarly if the materialisation of traffic is more than the anticipation what ingredients were responsible for higher generation and if the materialisation was lower than the anticipation what were the reasons for it. Have we done the postmortum on these lines so as to avoid the repetition in the successive plans of the same mode or of some other mode.

3. Railways

Looking into the problems of specific modes, it is high time for the railways to reduce and minimise the multiplicity of gauges so as to effect economy in the transportation cost and to avoid transhipment hardships. It is also high time for railways to streamline its organisational machinery into systems oriented instead of its continuing as function oriented organisation. Moreover as far as labour force is concerned will it be possible for railways to continue the unmanageable labour force and what measures were taken to adopt computerisation

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A background note by Dr. N.S. Srinivasan for discussion at the second meeting of the NCST sub-group on Transportation Futurology.

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and mechanisation with less labour intensive works (of course, this is to be viewed in the light of mounting unemployment problem in the country and alternative replacement proposals are to be worked out). The momentum gained by containerised traffic and the phase of containerisation are not in unison and warrants quick shift programmes to containerisation and unitisation.

In the case of statistical data, the data bank of railways though voluminous, does not provide ready data as regards to the cost of transportation of different units of different sections for different capacities so as to enable better planning for the future. Periodical economic appraisal of different lines and sections are also necessary to ascertain the economic viability. Is it not time to work out the traffic requirements at the micro regional level and to aggregate at macro level. What attempts were made or are contemplated to gear up the machinery to cater to the anticipated 400 billion tonne kms. freight traffic and another 400 billion passenger kms. of passenger traffic.

4. Road Transport

4.1. Rural Turning to the road transport what are the different types of infrastructure facilities available in different regions of the country, whether they can withstand the weather conditions and the traffic loads. The rural transport problem is of very high magnitude which involves massive dose of investment to make them achieve the minimum tolerable level, leaving aside the desired level. The spatial factors make the movement of traffic from the urban centres to rural areas and vice versa, on the poor rural and inter rural infrastructure. Whatever attempts made so far were highly inadequate and ineffective resulting in huge economic loss both to the nation and the vehicles. Is it not time to devote high attention to the development of rural highway and transport which are expected to carry about 600 billion tonne kms. of freight traffic and 665 billion passenger kms. of passenger traffic. Should we to allow bullock carts to dominate and even if we are to allow so, should we not resort to some innovative technology to make the flow smoother and easier.

4.2. Urban transport

Never the less the problems of inter-city and inter-region is no less and are similar as highlighted above. But the problems of the megalopolis and metropolitan cities are quite distinct and different considering the huge traffic generated by millions of people over the inelastic road space available in the megalopolis and metropolitan cities. Creation of additional super-structure and infrastructure facilities

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poses challenging problem. Though attempts were made in the recent past to regulate the traffic and plan the facilities in a few selected cities, still there are vast areas uncovered and unplanned. Are we capable of withstanding the mounting problem or is it not time to gear up the machinery to solve the problem at initial stages? Should we have enough expertise to plan and regulate the things and if not, what sufficient measures we are taking?

5. Inland water transport and coastal shipping

As regards to inland water and coastal shipping, we are to look back at their poor performance in the past. Considering the low and cheap cost of transportation, is it not high time to develop and foster this mode of transport atleast for specific bulk commodities like coal, petroleum and oil products, etc. to start with. Judging international standard level of 25 percent of traffic carried over by these modes it is high time to gear up our machinery to make them cater to the tune of atleast 20 per cent of the visualised futuristic traffic in the year 2000 A.D. The intensification, widening and deepening of the navigable canals and the introduction of tow-boats or some other vessels suiting our navigable systems are immediate requirements which would help this system to play a vital role in the transportation of goods and people.

6. Air transport

Next, the air traffic though constitutes a small share in the transportation of people and freight, is still have a vital role to play with the increase in the time conscience and consequent utility. The increase in the general economic level and the standard of living are likely to exert heavy pressure on this mode in the future. Have Indian Airlines and Air India visualised the futuristic pattern of demand and planned the Airport, terminal, and flight facilities for domestic and international traffic? What are the likely impacts of tourists traffic and what promotional measures were taken? What measures are taken to increase the capacity? Is it not possible to divert the first class railway passenger traffic and make them shift to air travel by cost reduction and increased utilisation of flight capacity? Will it be possible to increase the share of air traffic in the overall traffic to move than 5 per cent by 2000 A.D.

7. Pipelines

Pipe-lines though of recent origin is still a vital mode of transport both for solid and liquid materials. Considering the lowest transportation cost, the investment on this mode should not be barrier and wherever possible for whatever commodities transportable through this mode should be given top priority. Except a little bit of pipelines for the transportation of petroleum products what measures we have taken and are contemplated. What role can be assigned to this mode and what quantum of relief it can make on other modes are some of the factors to be pondered.

8. Geographical and backward areas

Hilly and backward areas are another field where specialised modes of transport like repeways are to be thought of depending on the economies of it and the geographical and terrain conditions of the area. What measures were taken to serve these areas and what mode of transport was considered best.

9. National Transportation Policies

It is time for us to admit without any prejudice that even after 25 years of independence we don't have a National Transportation Policy, except for a little work carried out by CTPC, Motor Vehicle Taxation enquiry committee, Intermediate and major ports committees/commissions etc. Is it not high time to bring out a white paper on National Transportation Policy clearly spelling out the aims, objective and goals of different modes of transport and the roles expected of each, and the likely shares of private and public sectors so as to provide a clear cut frame for the technologists, researchers and investors so that a healthy, integrated, and coordinated transportation development without distractions and distortions can take place in the country. Though perspective plans were worked out over a period of 15 years it is not throwing sufficient light to guide the future growth orientation.

11. Transport Technology

Under the changed circumstances particularly in the light of current oil crisis how long we are going to depend on internal combustion engines. Can we substitute oil with hydrofussils or something else? Should it be total revolution or making additions or modifications in the existing technologies and with what additional or new investments? Should the revolution be restricted to motor transport or all modes of transport? Will it not be interesting to wait and see the motivation generated by wind mills experiments under the active consideration of Tamil Nadu Government in sailing their coastal ships. What other technological revolutions can be thought of for other modes of transport to effect economy, speed and safety, in operation.

12. National Transportation Board and Investment

Last but not the least is the investment finance and budgetory constraints on the transportation sector. The piece-meal and lop sided investments on one or other transportation modes are likely to lead to duplication wastage and competition. Will it not be good to have a National Transportation Board to co-ordinate and integrate the planning, development and investment over various modes of transport keeping the national objectives in mind?

ROAD TRANSPORT IN THE YEAR 2000

By

Mr. R.P. Sikka*

GENERAL

1. For a clearer understanding of the road transpo scenario in year 2000, it must be disaggregated into two parts -

   a) urban traffic; and
   b) rural traffic.

Both look independent, yet they are closely interlinke and cannot but be considered in an integrated manner.

2. Urban traffic will affect rural transport in tw ways. Firstly, the continuing growth of population in urban industrial areas will require moving greater amo of food long distances to the cities. This will be in addition to the transportation burden due to intensifi agriculture to feed the increasing number of people, w will necessitate a greater variety of inputs to be mov from the urban sector to the farming hinterland.

3. The second aspect which will affect rural transport is the distribution of population in the future. Some urban scientists are of the view that by 2000 AD India will have five major megalopolises around Bombay Calcutta, Madras, Delhi and Lucknow. If this comes tr the pressure on rural transport to move food products one way, and finished goods the other way, will be ver much more than if the population is spread more evenly in cities of various sizes. Theoretical studies have shown that if a metropolitan city is built on the principle of "a hierarchy of centres", instead of a strong single centre as is witnessed in most of the cities at the moment, the total travel in the urban ar would be the least. Extension of this concept to the country as a whole suggests that if the burden of rura transport has to be lessened, the spatial distribution of urban population must be controlled by suitable measures. This point is again reverted to in the next section.

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4. The Futurology Sub-Group must weigh the above two aspects carefully so that a balanced picture of future transport requirements is obtained as a basis for further recommendations.

URBAN TRAFFIC

5. According to 1971 census, 20% of the people in India were compressed in urban areas. This is much too low compared to the industrialised world, for instance Japan is already 72% urban, Germany 74%, U.K. 78% and Australia 85%. In USA more than 70% of the population is concentrated in cities, and this is expected to touch the 85% mark by the year 2000.

6. Urban population in the country is, therefore, bound to increase, firstly due to natural rise in population, secondly due to greater industrialisation which requires more number of people to live together in concentrated communities, and thirdly because of the relentless migration of rural unemployed to the cities. Yes, the tide of urbanisation is irreversible, but can it not be checked and tamed to managable proportions so that the transport problem, already acute, does not aggravate further? According to UN projections, urban population in India will increase to about 26% in 1990. If the demographic curve is extrapolated further, possibly it will hit the 30% mark in the year 2000. Presuming the total population in the country to be 900 million at that time (projecting the population figures in the draft 5th plan), the urban population will approach 270 million compared to 120 million in 1974. This is bound to cause unbearable pressure on urban transport services unless by suitable actions the Government is able to channelise the urban growth along more constructive lines.

7. One disturbing factor of urban growth in the past is that it has been biased towards the larger cities while the smaller cities have been going into decline. For instance, in 1921 the share of urban population in cities with more than one lakh population was 25%, but by 1971 this had soared to 52%. The desire to live in larger cities is bad not only from the angle of urban traffic, but also the rural transport as stressed earlier.

8. One of the main planks of the future policy must thus be that the smaller cities should be encouraged to expand more than the existing big cities, especially those which have already crossed the 10 lakh limit in population This could be done in various ways, for instance by imposing controls on new industries, dispersal of administrative activities of the Government, etc.

9. One of the suggestions repeatedly made but consistently neglected is the creation of more number of regulated market towns to serve the rural area needs and increase their earning capacity by acting as a focal centre of business and commerce. If the thrust of urban population could be canalised into smaller rural towns of less than 20000 population, and secondly medium towns with less than 2-3 lakh population encouraged to expand more through different incentives, the pressure on urban transport so painfully evident in metropolitan cities could be considerably relieved. As an illustration, traffic studies in towns with around 2 lakh population have shown that about 88% of the trips in such cities are made either on foot or low-technology transport means like cycles, rickshaws etc. Dependence on public transport is much too small to be a source of bother. In contrast, in large cities like Bombay, Calcutta etc., about 90% of the trips are made by public transport. Although India may be self-sufficient in oil by the year 2000, it will be wholly unwise to squander away this scarce resource. The better course will be to encourage pedal powered vehicles as much as possible. China and Vietnam offer ample proof that this can be done with success.

METROPOLITAN TRAFFIC SOLUTIONS:

10. Despite a conscious effort to disperse population, as discussed earlier, it is inevitable that the metropolitan traffic problems will worsen by the turn of the next century A foretaste of this is the pattern of population increase between 1961 and 1971, when 57.3% of the urban expansion took place in relatively larger towns with over 50,000 inhabitant What kind of a policy package should then be conceived which will be effective and yet within our capacity to implement?

11. In the last 2-3 decades, Western cities embarked on a huge programme of creating new facilities for urban travel whether by way of expressways or underground tube railways. But the reaction to these facilities has been invariably mor traffic, and it has been found that the newly created capacity is soon absorbed without any dent in the former congestion. Reason for this is that new facilities act like a magnet to draw more people into the heart of the city, and instead of an equilibrium the transport situation worsens further. A prime example is Mexico City where the extra capacity of a new tube railway has been nullified in a very short time by the pressure of commuting public. Chastened by these developments, a number of cities like London, New York etc., have abandoned their plans of further road-building. A similar trend is emerging for tube railway projects. No doubt, there are also other demerits of the underground rail facilities which are contributing to these decisions, for instance high initial cost, inability to amortise the full investment through normal fare structure, long period of gestation, and the huge social cost to the community while the system is under construction.

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12. Our resources are already meagre. Therefore, if we want that the metropolitan traffic problems should be solved without over-stretching ourselves, it will be essential to think more and more in terms of a "no-build" solution. Accent has to be on getting the maximum out of the existing facilities through traffic management techniques and other measures outlined briefly below:

(i) Limiting the use of cars

Since cars inflict a disproportionate cost on other roadusers and the system as a whole, it will be necessary to curb their usage by physical and fiscal means. Physical restraints of different type are already current in Europe and America. In the second category of measures, the example of Singapore can be cited where licence fees on cars have been substantially increased in order to create better conditions for public transport. A further proposal is to introduce special permits for vehicles entering the central area during the peak hours. World Bank has also urged that developing countries should leavy a congestion tax on private cars occupying roads during the busy hours.

(ii) Modifying Urban Pattern to reduce travel

Different traffic studies (e.g. for Milton Keynes in U.K.) have shown that compared to onetralised employment, if a dispersed pattern of jobs is created in a city, the road space required will be about 50% less. This policy will have to be zealously followed in India by creating major suburban centres with integrated housing and employment so as to reduce the number and length of work journeys and give a fillip to low-cost modes such as cycling and walking. A number of different cities, for instance Rome & Tokyo, have launched such programmes. In Singapore, where the authorities have combined the scheme of creating integrated townships with removal of slums, the results have been very pleasing indeed.

(iii) Giving preference to buses

This can be done by going in for bus bays, busways, or according priority to buses at signals with the help of electronic devices, so as to get the maximum out of the available road space.

(iv) Encouraging new travel systems

Existing transport facilities will themselves be not able to satisfy the public demand in 2000. Other transport means which have shown their mettle elsewhere must be thought of to supplement the traditional

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facilities. In this category fall the para-transit systems like mini-buses, bus pools and jitneys (i.e. point-to-point taxi operation on per seat basis).

13. To sum up, in the area of urban traffic the main points deserving consideration of the sub-group are: a better spatial distribution of urban population; adoption of the no-build solution in major metropolitan areas; minimising travel by changing the urban form; getting the maximum out of the existing facilities by restrictions on the use of private cars; introduction of bus preference measures; and encouragement to para-transit systems like mini-buses and bus pools.

RURAL TRANSPORT

14. According to draft 5th Five Year Plan, requirements of goods transport by road would go up from 65 billion ton kms in 1973-74 to 110 billion ton kms in 1978-79. Over the same period, passenger traffic will increase from 130 to 180 thousand million passenger kms. What percentage of this traffic will be in the rural sector is not exactly known since the 5th plan document does not distingui between traffic in the urban areas and traffic in rural areas.

15. No precise forecasts about rural transport needs in the year 2000 thus exist. Nor are any proper statistics available on the basis of which a round assessment of transport requirements by the start of next century could be made. For instance, information is completely lacking about the extent of short haul and long-distance traffic on inter-city routes. This makes the task of prognosis extremely difficult. Two points could however be made abou future:

(i) Because of factors mentioned in paras 2 and 3 above, and also the gradual rise in living standards of people which will lead to more travel, demand on rural transport should show a upward climb compared to the trend of populatio increase.

(ii) Share of road transport compared to rail is increasing and this also will swell up the volume of rural transport. According to Planning Commission figures, 30% of the goods and 49% of the passenger transport was on roads in 1973-74. There is every possibility that by the year 2000, roads share of goods traffic may go up to 40-45% and of passenger traffic to 60%.

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16. The exact effect of above changes is hard to assess. But in broad terms, rural transport may be carrying four times the volume today when the next century dawns. As is the current experience, goods traffic should be moving in a two-tier manner, firstly from the farms to markets, and in the second leg from the markets to other centres of consumption. Impact of increased requirements can be very much lessened if greater reliance is placed in future on low-cost or intermediate technology transport means for the first leg of travel. This brings into focus modes like bullock carts, or improvised vehicles based on the principle of pedal cycle or wheelbarrow on which considerable research for the needs of developing countries is being carried out presently. Bullock cart efficiency can be vastly improved if these are fitted with pneumatic tyres and axles with ball-bearings. Since by 2000 countryside in India should be well provided with a network of all-weather rural roads, climate for improvisation of bullock carts and introduction of new systems yet in development stage will be very favourable. One big advantage is that these modes do not make a demand on the unreplenishable sources of energy.

17. Burden on conventional trucks could also be reduced in two other ways, (a) by the multipurpose use of tractor-trailers and (b) three-wheeler tempos, to transport goods between farms and the markets. This is already happening to some degree in certain parts of the country, for instance Haryana, Punjab and Western U.P. It may be prudent to encourage this trend so that manufacturing needs of new trucks can be kept within reasonable limits.

18. As a part of the strategy to promote intermediate technology the authorities must also develop a more intensive network of regulated markets so that villages are connected to centres of commerce with a much smaller travel distance. This will appreciably lessen the burden on mechanised transport.

19. As regards the movement of inter-city traffic, a much larger chunk will go to truck-trailer combination by the year 2000. At present very few vehicles of this kind are plyington highways in the country. In contrast, about 25% of the goods transport in USA, accounting for almost all of the long-distance traffic, is on articulated vehicles. Position in U.K. is nearly identical with 45% the total truck fleet being in the range of 11-20 tons, and another 10% in the range of over 20 tons. Main reason why articulated vehicles have not become popular in India so far is the deficiencies in the highway system. By 2000, the condition of highways, at least the principle routes, will be vastly improved. Mixture of vehicles on roads should therefore radically change in the coming

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years, and a large number of combination vehicles should be plying between cities. By following appropriate licensing policies, the share of articulated vehicles could easily be enhanced to 25%, if not more, within the next two decades. With that, the requirements of single-unit trucks will appreciably reduce. Another bright point of combination vehicles is their much less fuel consumption for each ton km of goods carried, which alone is reason enough why every effort must be made to change the transport patter in that direction.

20. Summing up for rural transport, the important issues are: encouragement of low-cost/intermediate technology transport modes for carriage of goods from farms to markets, improvements in the existing animal drawn carts with simultaneous introduction of new pedal-cycle systems presently in the stage of development; multipurpose use of tractor-trailers for rural goods movement; development of a better network of regulated markets to reduce dependence on motorised transport; and encouragement of articulated vehicles through licensing policies or otherwise for all long-distance traffic. Data needs in this regard are very acute. The Sub-Groupt may like to have a few sample studies carried out about (i) the present role of animal drawn vehicles in rural transport, and (ii) the extent of short-haul and long-distance traffic between cities, so that a better basis for formulation of recommendations is available.

AIR TRANSPORT SECTOR IN INDIA IN 2000 A.D. : A FUTUROLOGICAL VIEW - AIR INDIA

1. Introduction:

1.1 Interest in Future Studies and a concern for the future mainly derives from the experience of post-industrial societies engaged in extending the frontiers of technology. In doing this, these societies have discovered suddenly, as it were, the fact that global resources are finite and the exploitation and consumption of these must make some vital concessions to the future. The oil problem in the last couple of years has only highlighted this dramatically.

1.2 The concern for the future and interest in Futurology in developing countries is more mundane. As far as technology is concerned, their problem is to harness the already available technology on the required scale often leading on to a resources problem. The competition for resources between the present and the future is keener still if these countries are densely populated, which enlarges the moral responsibility of the decision makers. In India, with the burden of population that we already carry and the prospect of its increase close to a billion by the end of the century, even spectacular changes when reduced to a per capita basis would not remain equally spectacular. Therefore, with an anticipated modest rate of success against the host of problems, it is all the more necessary to conserve resources and channelise them. Our concern therefore is in 'preparing' for the future or indeed'preparing' a future. It is in such a context that 'normative' Futurology on the lines of 'creation' of a 'possible' future becomes relevant. Such Future studies in the context of a developing country would give pointers indicating how decisions and measures taken at different points of time can act on the course of events.

1.3 One may be tempted to view the future of developing countries as being similar to the 'past' of the post-industrial societies of today. This, of course, could be true, if at all, in a very broad sense viz., secular trends in production or sectoral shifts in the economy etc. There are a host of factors economic and social that are uncommon between the (past' of the post-industrial societies and the developing countries of today. One of the dangers to be avoided then, is the thoughtless transfer of technology which may be wasteful or unsuitable given the resource-endowment of the adopting country.

1.4 At the same time, some of the post-industrial technologies may be straightaway adopted by the developing countries thus leap-frogging and gaining several decades in time. This is what makes an otherwise mundane task of tackling the future in developing countries exciting. The use of nuclear fuel to generate power is one such example in the case of India. The view that Dr. Bhabha took at the time he recommended the establishment of nuclear power stations in India is a typical instance of a futurological outlook in the context of a developing country. The Satellite Instructional Television Experiment (SITE) which uses Space Technology for educational TV programmes aimed at national development is another case in point.

1.5 Air Transport is yet another post-industrial technology which has left little choice for the developing countries which place a premium on speedy communications, more especially if they happen to be large geographically like 'Brazil' or India. Basically for very sound economic reasons and secondarily for competitive reasons, the equipment deployed in air transport tends towards uniformity as between the developed and the developing countries. Even the basic facilities required to enable operation of aircraft are again invariant though admitting of varying degrees of sophistication. The air transport sector in a developing country is thus an 'enclave' which stands at one extreme end in the scale of application of technology to the daily needs of society. This additionally highlights the juxtaposition on a horizontal level of different time-perceptions.

1.6 A study of air transport in India to 2000 A.D. really amounts to a study in Futurology at a sectoral level. At the sectoral level the connection between future studies and planning problems (and decisions) with long-range consequences becomes very intimate. In order to plan and prepare for a future, it is necessary to identify the areas of impact and to assess the magnitudeor scale or air transport activity in India in 2000 A.D. This is best done by constructing a scenario of the Indian air transport scene as it most probably would look 25 years later. Before doing so, it would be useful to take a brief look at the technological context.

2. Technology:

2.1 In an attempt to visualise a future 25 years hence, one has to reckon with possible and inevitable changes in technology. This need not be a purely speculative exercise. Chance elements will always be there which can never be forecast. However, in the matter of foreseeable changes in technology in aviation, one is on surer ground by proceeding on the basis of monitoring signals of technological change. At this time, it appears that there is an imperative necessity for alternative fuels for aircraft to get away from dependence on oil. Several alternative fuels including liquid hydrogen are being considered togetherwith their impact on future design of aircraft. Experts believe that almost 10 years would be required for research on all available options to enable picking the ideal and another 10 to 15 years to organise new industries, distribution systems and related infra-structures. The fact that oil deposits are distributed over different areas of the world where it is processed and refined and the fact that different oil products have other industrial uses has played a very significant role in aiding international air transportation. Such a facility would not apply if liquid hydrogen replaces oil for aircraft. In that event, the new fuel would have to be pre-transported for a storage in different parts of the world and hence considerable time and resources spent in organising distribution.

2.2 Another empiric rule suggests that at least 20 years are required to start with a new idea and follow it through until wide-spread use of results coming from that idea are realised. This period of 20 years is also co-incidentally the time span which takes for replacing of one generation of men by another. Therefore by the year 2000 A.D. aircraft based on new fuel(s) would probably be just making the scene.

2.3 Supersonic Transport (SST) technology is already with us in the shape of the Concorde although in its commercial exploitation at this stage, it still requires a premium on present fares, for viability. This would of course change and by the year 2000 A.D. Supersonic aircraft would be in regular use on most of the world's high density routes having a market segment with a premium on time. In keeping with the trend of increasein average size of aircraft, the wide-bodied aircraft in 2000 A.D. would have capacity to carry between 750 and 1,000 passengers. This would bring about qualitative changes in the type of service. On these aircraft, a large section would be earmarked to cater to a no-frills class of passengers with the basic emphasis on point-to-point transportation. This classmight effectively compete with other modes of transportation thus widening the base for air travel. All-cargo aircraft, keeping in step with their passenger countparts would have capacities in the range of 500 tonnes.

3. A Scenario

3.1 Although counted among the developing countries today, India has the necessary sophistication in technology to enabl it to catch up with the leading powers in some areas. By the end of the century, India would have the technical capability to manufacture commercial jet aircraft. Medium and small aircraft could well be manufactured to meet our own requirements and even for export. Large aircraft would still be imported to keep up with international standards and for competitive reasons.

3.2 Air India:

3.2.1. Air India's route-net work would have stretched to South America and across the Pacific making it a round-the world operator. Situated as it is at the cross-roads of traffic between the East and the West, India's geographical position would have been exploited by Air-India to consolidate its position as one of the leading operators in Asia.

3.2.2. Traffic carried by Air-India would have increased 11 times assuming an average annual rate of growth of 10% or to 17 times at an average annual rate of growth of 12% over the planned level for 1975/76. The lower of the two i.e. a eleven-fold increase can be supported on the grounds that Air-India has, on the average, exceeded the Industry's performance in the past. This may be expected to continue as Air-India would still be a small but growing operator vis-a-vis the Industry whose rate of growth would lag on account of the massive base.

3.2.3, An optimistic seventeen-fold increase in the scale of operations could very well come about for a variety of reasons. As it is, cargo growth is outstripping passenger growth and if this trend continues, aided by more all-freighter operations, it would push the overall rate of growth to higher levels. Secondly, Air India could secure a better market share in many markets. Thirdly, additional stimulus could come from the home market. In this context, it should be recalled that in the past, Air-India's operations grew in scale on the strength of the markets abroad and the market with India as its destination. The stimulus that Air-India got from the relaxation of the 'P' F in 1970 is an instance that could occur in different ways in the future. A higher rate of growth of GNP than foreseen at present based on break thoughs or in organising men and resources in a different manner, albeit in a democratic context, can be expected. India's home market of orginating international passengers would then play a vital role in the operation of Air India.

3.2.4. Air India's fleet would most certainly consist of Supersonic aircraft. The basic fleet would of course be the later versions of the wide-bodied aircraft seating 750 to 1,000 passengers. The narrow-bodied B-707 type of aircraft would have been phased out completely as even now no more additions of such aircraft are contemplated. Standard versions of the B-747 or the B-747 SP or DC-10 or L-1011 to be added at the end of the 5th Plan (1978-79) or thereafter could very well be operating upto the mid-1990s. Such aircraft may manage to be on the fleet of Air-India to sustain operations to the countries of the Gulf or other neighbouring countries. The size of the fleet would naturally not increase in proportion to traffic even at a constant load factor, due to the increase in the average size of aircraft.

3.2.5.An organisation of the size that Air-India would be in twenty-five years will imply its own structural changes. Like the hotel subsidiary, we have today, it is possible to forsee a separate freighter subsidiary to cater to the increasing pace of cargo traffic with all-cargo wide-bodied aircraft. Similarly, to promote tourism and handle all its aspects a Tourist subsidiary may be warranted. Indeed, one may well wonder whether the current organisational and structural distinction between Air-India and Indian Airlines would remain in essentially the same shape in 2000 A.D. Some reasons that give rise to this though become apparent in examining the domestic air transport scene in the next twenty-five years.

3.3. Indian Airlines:

3.3.1.Indian Airlines' future growth will have to be a complete break from the past. There are compelling reasons to propagate this view. Since nationalisation, Indian Airlines' growth in capacity and traffichas been well below an average annual rate of growth of 7%. Indian Airlines today stands on a different footing. It is a homogenous organisation now when compared to the early years of nationalisation. Its fleet is rationalised and is getting more and more standardised. Indian Airlines' entry into the wide-bodied era in 1976 with the acquisition of the Airbus would see the phasing out of the Caravelles too. These wide-bodied aircraft will also enable expansion of the domestic air-cargo market, an area where no worthwhile changes have occured in the last decade. All in all, Indian Airlines is set for a high productivity performance in the years to come.

3.3.2.Indian Airlines' scale of operations can be projected under two alternative rates of growth. The low projection would imply an average annual rate of growth of 9% resulting in a scale of traffic performed which would be a ten-fold increase by 2000 A.D. over 1973-74. A high projection at 11% average annual rate would result in a sixteen-fold increase by the end of the same period.

3.3.3. A rate of growth of higher than 11% is not postulated considering the fact that domestic air transport is more susceptible to the vagaries of the performance of the national economy and even to fiscal and other Governmental policies. Higher rates of growth may be experienced over given short spans but they may level off over the long run.

3.3.4. Indian Airlines today has what is termed as 'turn-away traffic' lost to rail and road on many sectors. It is assumed that the high rate of 11% assumed above would have ingested this kind of traffic. In this context, it is to be expected that on short and medium sectors, there would be serious competition from surface modes like high speed rail. On the other hand, opening up of more airports and wide-bodied aircraft operations to the present 'bottle-neck' airports (e.g. Cochin) would stimulate traffic to help realise the higher of the projections.

3.3.5. The network of Indian Airlines would have expanded to cover at least twice the number of cities it serves tod To bring this about, many new airports would be in operation in addition to improved and modernised versions of th presentones. Upgrading of many airports to receive wide-bodied aircraft would also enable international flights to operate to such points as Ahmedabad, Bangalore, Cochin Trivandrum, Goa, Nagpur, Banaras and Srinagar. Direct international flights could operate to/from some of these points. Many more places of tourist interest could also have their own airports much like whatKKajuraho has today.

3.3.6.The fleet of Indian Airlines which would still not have Supersonic aircraft may consist of three or four type of aircraft. The large 750-1000 seater would qualify for trunk routes, the later versionsof the Airbus, for trunk and feeder routes, and aircraft of a capacity around a 100 seats for local routes for third-level operations. Aircraft with a capacity below 100 may not be operated except on very low density routes, if still served by Indian Airlines. Although VTOL and STOL aircraft would in all likelihood be available for commercial use, it is difficult to imagine diversion of capital funds for purchase of such aircraft and for building of STOP-ports in India. The investment would most probably be diverted towards improving access to airports.

3.4. Airports:

3.4.1. The volume of air traffic in India, both Passenger and Cargo, in 2000 A.D. would naturally include the operations of foreign airlines into India, besides Air-operations of foreign airlines into India, besides Air-India and Indian Airlines. Therefore, it would be appropriate to examine the scale of this traffic at the point where traffic growth impinges i.e. at the four international airports.

3.4.2. As an illustration, in the following two tables, th grdwthrg8,passenger and cargo traffic (domestic plus international) that the four international airports is projected at different hypothetical rates of growth. Constant rates of growth over such a long period as 27 years (1973-74 as base) is obviously a gross simplification. Nevertheless, the resultantvolumes of traffic do indicate a range of the magnitude of the activity that we may have to content with:

TABLE I

TERMINAL PASSENGERS - 2000 A.D. - (Millions)

	7%	9%	12%
Bombay	13.743	22.635	47.210
Delhi	10.396	17.122	37.711
Calcutta	5.608	9.236	19.264
Madras	2.919	4.807	10.027
Total :	32.666	53.800	114.212

TABLE II

CARGO HANDLED ('000 TONNES)

	9%	11%	13%
Bombay	440	719	1,164
Delhi	215	351	568
Calcutta	92	151	244
Madras	71	117	189
Total :	818	1,338	2,165

3.4.3. A very conservative estimate of the volume of passenger traffic at the present four international airports in 2000 A.D. would be an increase of 6 times compared to 1973-74. A more realistic estimate would be the medium estimate which yields a multiple of 10 times over 1973-74. What is even more likely is a combination of different rates of growth for different airports, say, 9% for Bombay, 12% for Delhi, 9% for Calcutta and 7% for Madras. Similarly in the case of cargo, the minimum multiple is a 10-fold increase over 1973/74 or a realistic sixteen-fold increase or a combination of the different rates for the airports. This cale of traffic foreseen for the (present) four international airports is by no means the complete picture. To this one has to add the traffic at the other airports (presently under DGCA) in the country.

3.5 Tourism

3.5.1. For a country of the size of India with the variety it has to offer to the tourist, the number of tourist arrivals at below half a million at present is exceedingly small. Projected at an average annual growth rate of 10%, this may be expected to reach a level ten times higher moreover 5 million by the year 2000. An ambitious projection of growth would involve an assumption of doubling of scale every five years, resulting in around 17 million tourists by 2000 A.D. Even this level is not high for India considering the fact that many smaller countries like Spain far exceed this level even today. India's capacity to absorb tourists would therefore be a critical factor in this rapidly expanding industry.

3.5.2. Two other areas connected with aviation offer tremendous scope for development. First is the field of agricultural aviation. Hindustan Aeronautics already manufacture 'Basant' suitable for aerial spraying. Considering the large area under crops in the country and the increased need for crop-protection measures, the demand for agricultural aircraft is bound to increase manifold. Secondly, highly skilled manpower in the form of trained pilots would be available probably on a scale larger than can be absorbed within the country. Such manpower opens several possibilities with emphasis on training either by deputing them to other countries or by offering training facilities in India.

4. Planning Aspects, Supply and Development:

4.1. The scale of air traffic foreseen for 2000 A.D. indicates the level of demand to be met. Obviously Air-India and Indian Airlines would increase their fleet size to meet the needs of the market and to keep the market shares. This is not the place to go into the perspective plans of the two airlines. However, one broad observation may be made: higher productivity of aircraft (based on speed for the SST and on scale for the wide-bodied) will ensure that even at constant load factors, the size of the fleet will not have to grow proportionately with the growth in traffic. It is just as well because this is what alleviates the capacity problem at airports as the number of departures will not grow in proportion to increase in traffic.

4.2 Inspite of the relief due to the growth in the average size of the aircraft, airports would still have other problems of growth, especially, peak period passenger handling. As each level of facilities gets saturated, additional facilities including separate cargo terminals will have to be provided and this has to be anticipated at least five years earlier in the case of expanding of existing airports. In fact, Air-India would itself require a passenger and cargo terminal in Bombay and Delhi for exclusive use by 2000 A.D. The Tata Committee on International Airport felt that in Bombay, Calcutta, and Madras, a saturation point would be reached before the end of the century and this assumes that their recommendations would have been implemented. It is only in the case of Delhi where there is scope to have a parallel runway that saturation would lie beyond the turn of the century. Alternate airport sites would therefore be inevitab at Bombay, Madras and Calcutta. In planning these new airports, advance action at least ten years before they have to become operational is required, and this includes acquiring and earmarking suitable sites in the face of encroachment due to urbanisation. Development of these airports would have to be an integrated one having regard to the interfaces with environmental elements like land use, noise, pollution and airport access.

4.3. Mention was made earlier about more international airports. In this connection, traffic trends at candidate airports now under DGCA should be studied with a view to converting them to international status at the right time. This is imperative because it will simultaneously reduce (relatively) the volume of traffic handled at the present four international airports and thus help postpone their saturation point.

4.4 Investment in tourism infrastructure will have to be planned depending on the kind of facilities required - whether luxury, semi-luxury or functional within the lead time required to commence these projects. New resorts like beaches and sites of historical importance catering to special-interest groups have to be developed in conjunction with the archaeological and/or other appropriate agencies

4.5. The supply aspect of the air transport scene insofar as it relates to aircraft and capacity would be internal to the airlines i.e. Indian Airlines and Air-India. This will depend upon their own progressive projections of demand and the extent to which they are matched by actuals. The resources for such expansion would come largely, if not entirely, from these very airlines. The sphere of Governmental action would lie in providing the supporting infrastructure in the shape of airports, aeronautical facilities, access networks and tourist facilities on the required scale. The resources for such investment would have to come from general budgetary sources. This implies the setting-up of priorities in such a manner that the air transport sector gets the required investment for its developmental needs. This is where the future strategy has to be mapped out and it is never too early to make a beginning.

5. Conclusion:

5.1. Mapping out the further on a sectoral level must nevertheless be viewed in the context of the larger aggregates viz. the transport sector covering other modes of transport and the economy. It is well to remember that even allowing for reasonably good growth rates, the domestic air transport scene will remain quantitatively small in magnitude. For example, in 2000 A.D. the per cent share of air passenger kms. and/or freight tonne-kms. will be less than 5% of common passenger kms. and freight tonne-kms. Its impact on the economy, however, would at least be in inverse proportion, in that, economy of time (or time utility) brings the future nearer.

5.2 The pace of approaching the future itself might undergo a rapid change, if, for example, we come across a breakthrough in agriculture and/or discover oil deposits on a wide scale in the areas we are prospecting today. This could transform the economy completely and place it on a higher plateau. Growth rates resulting in a doubling of scale every four to five years might be experienced over many sectors of the economy and air transport would be the beneficiary of the resultant cross-impact. In that event, successive scenario may bringmore within the realm of the (possible) those considered 'probable'. Breakthroughs apart, the accelerating pace of technological change confirms our belief that twenty-five years is a long enough time to fashion fiction into fact.

URBAN FORM AND THE PUBLIC TRANSPORT SYSTEM

by

Santosh Sharma, General Manager,
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INTER DEPENDENCE OF URBAN FORM AND TRANSPORT

Urban form and transport are intricately interrelated. Transport must form part of an overall integrated development plan in a city as a whole. Initially, the urban transport is influenced to a great extent, by the urban form and caters to the movement pattern flowing from the urban form. However, as the urban areas grow in size and activity, its movement dynamics become dependent upon a variety of complex reasons. The inter dependence of the urban growth process and the transportation system makes the problem very complex. A good transport system can be an effective catalyst and a good tool to trigger urban growth and can, to a great extent, shape the form of the urban structure. On the other hand, a poor transport system can create social tensions and unrests and seriously disturb planned urban growth. For a balanced development of the urban system as a whole, the interdependence of the two needs to be clearly appreciated and a coordinated plan evolved so that the one compliments the other. Various factors contribute to the inefficiency and inadequacy of a transport system resulting in economic loss to the system and poor level of service to the community. Poor maintenance standards, unscientific route patterns, inefficient schedules and improper locations of workshops and terminals are some of the contributing factors. Efficient fleet management is a management function which a competent management should strive to achieve. In this endeavour, it will however need considerable support from the urban planners and the city administration and unless such support is forthcoming the development of a full system may be just a dream.

SCIENTIFIC DESIGNING OF A BUS SYSTEM

The significance of designing a bus system on scientific lines with a view tooptimize the use of a given fleet, is often not fully appreciated. A scientifically designed bus system can considerably reduce the total requirement of buses for carrying a given load thereby not only resulting in substantial saving in capital investment on buses and on operating expenses but also leading to various consequential benefits in the shape of reduction in congestion, air pollution, noise, cutting down of man-hour wasted in waiting and transit and reducing over-loading with resultant increase in safety, comfort and speed. The savings to the national economy in terms of fuel costs, can also be considerable. If the public transport systems were adequate to reduce the number of cars on the road in Delhi by, say 25%, the saving to the National economy would be of the order of 25 million litres of petrol per year while the additional consumption of diesel would be less than 5 million litres. This alone would result in annual saving of more than Rs. 7.5 crores at current market prices. A scientifically designed public transport system thus leads to a variety of social, economic and environmental benefits, some of which are hard to quantify but, nevertheless, considerable.

3. The above analysis has various policy implications. It underlines the need for a comprehensive implementation plan dealing with proper development of maintenance infrastructure, development of man power, improving work procedures and designing of a proper operating system for optimizing the fleet utilization. It emphasizes the need for a systems approach for development of complete management system. It calls for proper orientation of investment, planning so as to adequately provide for related improvements for making the most productive use of investment on buses. It urges the urban planners and the city administration to review their plans and policies so as to meet fully the needs and requirements of the public transport system. This paper is primarily intended to focus attention on the inter-action of the urban form and the public transport system and the urgent need for full involvement of the urban planners and the city administration in the designing of a full system.

4. Scheduling of public transport services readily admits itself to modern optimization techniques, though this fact is often not fully appreciated, even at the professional level. The problem basically is of designing a system which would optimize the use of a given fleet. In other words, the exercise is to find the minimum number of buseswhich would be required to carry a given load. At the same time, it is equally important to achieve a high level of service by providing high frequencies. Good frequencies are a sine-qua-non of intra-urban system and no optimal solution would have any relevance unless it takes care of this aspect. Another important, but extremely difficult, aspect of urban route planning is designing of a network which would enable a commuter to reach his destination by the shortest route. If a person wanting to travel from A to B is made to trave viz. C, D & E which are not on the shortest route (either in distance or in time scale) between A & B, it will not only increase his travel time but will result in unnecessary blocking of the passenger seat for a much longer period than if he had been made to travel by the shortest route thereby substantially reducing the effective carrying capacity of the system.

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5. With a given fleet, high frequencies will be possible only if the number of route is kept to the minimum. If an effort is made to connect every traffic originating point with every destination point by through services, the total number of services may become so large that reasonably good frequencies may become impossible to provide. Elementary mathematics tells us that if n points are to be interconnected with each other by direct routes, the total number of routes required would be $\frac{n(n-1)}{2}$. If, however, a nodal exchange is introduced, the number of routes required would be only n. Thus if 40 points are to be linked with services, the number of routes required in the traditional system would be nearly 300 whereas in the nodal system the number of routes require would be only 40. The example is an over-simplification but the message is clear - if good frequencies are to be provided, some nodal stations will have to be introduced. The succeeding paragraphs discuss the nodal concept in some details.

6. Though the urban characteristics and land use pattern vary from city to city, a common feature is the presence of a high density central urban core surrounded by suburban areas where the population density and, consequently, the traffic intensity gradually fade out. The treatment of the water-shed between the high and low density areas is an important aspect of the optimization problem. It is easy to demonstrate that a high level of fleet utilization and high occupancy ratio can be achieved by providing feeder and radial services terminating at the nodal point separating the high density and low density areas. Since there is a sharp change in the intensity of the traffic on either side of the nodal station, the vehicles tend to be under-utilized if through services are provided between the sub-urban and the urban stations.

7. Another optimization technique in transportation is forcing traffic into traffic channels or corridors thereby enabling high frequencies with high occupancy ratios. This technique has been extensively used in designing rapid transit corridors where, through a judicious use of feeding and exchange points and inducing traffic through efficient and frequent services, a high level of traffic intensity is achieved on the corridors. Unfortunately, this technique seems to have been completely overlooked while designing bus systems. To some extent, the feeder radial concept outlined in the earlier paragraphs helps in increasing the intensity of traffic on the radial routes but, again, unless some further innovations are introduced.

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the traffic intensity may be uneven or unindirectional and the carrying capacity may be underutilized during most of the day. Here, the introduction of one or more major exchange nodal points within the urban core may prove extremely effective. If these exchange points are made very efficient by providing a number of exchange options on high frequency services, it will have the effect of inducing traffic on the radial network thereby not only evening out the occupancy through out the day but also, on account of the exchange involved, achieving fairly good occupancy in both directions. The number and location of these exchange terminals will, undoubtedly, depend upon the city layout and landuse and will have to be carefully determined by the systems designer.

8. The traditional system in which effort is made to connect several origin and destination points by through services can be described as a 'Destination Oriented System' where a commuter waits for a particular bus which would take him to his particular destination. This bus will generally, have a low frequency, and he may have to wait a long time until the particular bus arrives. It would be no consolation to him if a large number of buses bound for other destinations pass by. Under the nodal system, a commuter is induced and encouraged to travel in the general direction of his destination by the first available bus. Thus, if he wants to commute in the general service proceeding towards the nearest node in the southern direction and there make an efficient exchange for his destination thereby substantially reducing his waiting and travel time. Long queues of waiting passengers would become memories of the past. The radial-feeder concept and the concept of traffic channels which are inherent feature of the nodal system, encourage direction oriented travel. The system thus aims at optimisation by bringing about a radical change in the travelling habits of the people.

9. The concept of exchange terminals is not a new one. Such terminals have been established in most principal cities, though their functions and effectiveness vary from city to city. Actually, exchange terminals are more extensively used while designing sub way systems and their utility in bus systems is not so well appreciated. Establishment of exchange terminals is some-times criticized on the ground that changeovers entail some inconvenience to the travelling public. However, if the exchanges are efficient and quick, the overall travelling time is substantially reduced because of the routing which the exchange terminals make it possible to develop. In fact, the entire effort is to switch over from a large number of small and inefficient exchange points to a few major and efficient exchange terminals.

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10. The location and designing of the exchange terminals will play a very important role in the designing of the optimal system. The urban planners will have to carry out a careful study of the city layout and land use, identify the urban and suburban characteristics, study the radial roads could be developed into traffic channels and select the location of the exchange terminals on the basis of these studies. The availability of land may prove a serious constraints in locating the terminals. The city planners will have to realize that if the city is to move, the terminals will have to be established. The terminals will not only have to provide for bus berthing and circulation, enquiry booths and passenger facilities but also for adequate parking space for other modes like cars, taxis, scooters, cycles etc. so that people may be encouraged to reach the nearest terminals in their personal transports and exchange on to the high frequency bus service for the rest of their journey. The supplemental role which personal transport and other modes like taxis will play to the bus system, will be a key factor in optimizing the utility of the bus system and will be feasible only if the exchange terminals provide f this facility. It will be extremely desirable to provide adequate land may be 10 to 15 acres - for each major exchange terminal for providing not only the aforesaid facilities but also for adequate greens and open space for proper landscaping and for other environmental considerations. If adequate land is not available, the use of the available land will have to be optimized by taking some of the services like passenger facilities and parking of light vehicles under ground. The exchange terminals willhave to be designed carefully for optimizing the use of the valuable land and it would be worthwile to engage qualified, imaginative and progressive traffic engineers and planners on the job.

11. Quite often, the commitment of land expenditure on establishment of terminals are considered unnecessary and wasteful. Passenger amenities at these terminals, it is argued, are luxuries and 'frills' to an operating system which can be added when better times come. This is a very naive approach and leads to distortion in land use alocation and investment planning. Establishment of exchange terminals is an essential ingredient of an optimal system and only by establishing such terminals can the best use of investment on buses be made. In most countries, bus transpor has, in the past, been identified as the common man's made of travel and the socalled elite have accepted it with indifferent tolerance, though the recent hike in the price of petroleum products has brought about certain changes in attitudes. If a major shift from personalised transport to public transport has to be brought about, the public transport system will have to be designed to the clean, efficient and adequate with sufficient passenger conveniences

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and minimum delays at the exchange terminals. Environmental considerations also require that the exchange terminals should be designed to be efficient and lean. It is not suggested that massive concrete structures need to be constructed at these terminals for providing the various conveniences. In fact, such structures will have to be avoided and, as mentioned earlier, adequate space allocated for greens and open areas.

12. Delhi's transportation severely suffered from a poor routing system which had grown haphazardly over the years. The system consisted of a large number of low frequency services circuiting through the city and was characterized by substandard operations, uncertain services, long waiting times and was highly wasteful of its carrying capacity. The urgency and importance of redesigning of the routing system was realised as early as in 1970 when the Morarka Commission urged the need for rationalizing the system. The Central Road Research Institute was entrusted with the job of undertaking these studies and a special officer was appointed by the Delhi Transport Corporation to study the proposals made by the institute.

13. In 1973, the Corporation seriously addressed itself to studying the fundamental defects in the routing plan which were the cause of the poor operations. The feeder-radial pattern of operation introduced by the Pallavan Transport Corporation, Madras at Saidapeth attracted its attention and studies were made to see if similar operation could be introduced at places like Azadpur, Dhaula Kuan, etc. In December, 1973, the Department ofScience & Technology, Office of theEnvironmental Planning &Coordination, proposed certain optimization concepts and suggested a conceptual plan which offered a solution for the complicated public transportation problem of the capital. The management immediately realised that the Khosla Plan, as this plan came to be generally referred to, offered exciting possibilities of developing an efficient operating system. Further studies were immediately taken in hand with a view to draw up an implementation plan. The Department of Science and Technology, Office of the Environmental Planning & Coordination worked in close cooperation with the management on this project.

14. On 1st March, 1974, the first phase of the reorganization programme was launched by introducing on an experimental basis, a net work of high frequency services converging into a central node from nine traffic focal points on the periphery of the central part of the city. The distinctive features of these services, now called Sugam, were good frequency, reliability, straight clear routes and a number of efficient exchange options at the central node. The central node was deliberately kept away from the city centre (Connaught Circus) and eight out of the nine services were routed in such a way as to avoid Connaught Circus to prevent delays and reduce travel time. (It is significant to

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note that more than 50 of old services passed through the busy Connaught Circus thereby wasting the time of both commuters and buses). A concept of direction-oriented travel (as opposed to the destination oriented travel which had been attempted in the old system) was thus introduced. The efficient exchange facilities at the central node allowed, for instance, a passenger from North Delhi wanting to commute to any part of South Delhi to take the first bus that came his way and change over to the appropriate bus at the central node.

15. The plan was a total success. These services took the city by storm and, perhaps for the first time in many years, commence favourable to the Corporation started appearing frequently in the press. Encouraged by this response, the management intensified its studies to explore all possibilitie and innovations to design a complete system. Yet, it proceede with great caution and strong resisted demands for additional new services or extensions of the already introduced.

16. On the 22nd May, 1974, the second major phase was launched with the introduction of a high frequency service called the Mudrika Seva, on the ring road. The layout of Delhi is circular in character and the ring road designed as a traffic diversion road, broadly divides the urban high densi areas and the peripheral low density areas. The earlier surveys and data had not revealed any circular pattern of movement in city. However, Mudrika proved an even greater success and drew immediate public appreciation. The principal reason for its success was that it enabled a commuter to reach very quickly a point in the general vicinity of his destinatio from where he could make an exchange on to another service or another mode of transport, to arrive at his final destination. On the 17th July, 1974, the Times of India editorially observe

> "In the last year, Delhi's bus system has shown vast improvement. An outdated network of routes has been recast and rationalised; a better utilization of DTC's fleet of buses has been accomplished ... The old destinational flow of buses, linking various outlying points with downtown centres, used needlessly to tie up buses in a hopeless maze of long routes. The directional system now introduced enables the running of a more efficient service between far out areas and certain nodal points to which a variety of short feeder routes are eventually to ply......"

17. After the operation of the Mudrika, there was no going back. An intermediate terminal was established at Karol Bagh and nine peripheral terminals were identified on the Ring Roa

As new buses arrived, new services converging into the terminals were introduced and old services were gradually and imperceptibly withdrawn. The phasing in of feeder services brought the peripheral terminals into full play. Though, off and on, there was some public resistance against changes in the system, people soon adopted to the new pattern and, in fact, demands for more radial and feeder services started pouring in. In less than a year, over 400 buses had been switched over to the new system. A complete master plan of operation under the new nodal system is under finalisation and is proposed to be introduced within the next few months.

18. The new pattern of operation drew international attention. The New Scientist of Lond observed :

> "By introducing direction-oriented rather than destination oriented trave, Delhi's buses became able to carry 40 per cent more passengers with only a marginal increase in fleet size. This software rather than hardware solution is a classic instance of the use of appropriate technology, relevant to London and other western cities".

The foundation for a well integrated public transport system for the capital had been laid.

19. The reorganisation of the Delhi Bus System, in actual fact, involved much more than the redesigning of the operating system. The management realised that only an integrated systems approach could offer a lasting and effective solution. A comprehensive programme of improving maintenance facilities, work procedures, manpower development, inventory and stores policies, etc. was launched. Starting with six old depots built over the past twenty years, the Corporation launched a major construction programme to construct a dozen more within a year. Eight of these have already gone into operation. Great care was exercised in designing and equipping the new depots with a view to make them functional, efficient and productivity oriented. The workshop was completely segregated from the administrative and operation block, thus promoting greater efficiency in the workshop. Through better and more systematic work procedures, the productivity of the central workshop was substantially improved. Against the average monthly overhauling of 40 to 45 engines in the previous year, the monthly engine overhauling was stepped upto over 100 in 1974 and that too with fewer men in the shop. The unit replacement system, covering all assemblies, is in the process of implementation and will result in improved control over the flow of spares and material.

20. For proper manpower development and fuller utilization of the manpower, the entire recruitment policy was reorganized. Recruitment of unqualified manpower was banned and only matriculate or ITI boys were recruited as apprentices for the workshop. 50 Engineering Graduates and over 200 diploma holder apprentices were recruited for building up the technical, managerial and supervisory cadres. Comprehensive training programmes for the apprentices were designed. A unique step was the extension of the apprecnticeship programme and the introduction of the multiple job concept for the operating crew. The multiple job concept promises much, not only for the employees in the form of better promotional avenues but also for the organization since it is expected to lead to a reduction in the staff-bus ratio through better utilization of the man-power.

21. The stores and inventory policies were redesigned to improve the availability of stores and reduce inventory holdings. The entire range of spares was codified and mechanized by introduction of an IBM 447 machine. The bus was subjected to a comprehensive study in consultation with professi product and graphic, designers to make it more functional, safe and comfortable. The new bus design and graphic styling is not only pleasing but also more economical and easier to maintain. The pay-as-you-enter seating arrangement evolved by the Corporation substantially improved the ticketing system and was well received both by the commuters and the crew. The success of the measures taken and of the partial operating system introduce so far, is indicative of the fact that the approach adopted is sound.

22. The above analysis clearly established the need for a number of exchange terminals and subnodal stations for designing an optimal bus system. The exact requirement of terminals would depend upon the urban form and its growth patte Nonetheless, the requirement of land, quite often, may be substantial and, that too, in strategic areas which, the urban planners and the city administration may feel hesitant to provide. In Delhi, for instance, the requirement of land for establishing 11 or 12 major exchange terminals and 4 or 5 subnodal stations may be of the order of 150 to 200 acres. This may, at first sight, appear to be excessive and wasteful and, i the fact of competing demands for other land uses, the urban planners and the city administration may find it difficult to provide. However, for designing a good bus system, the land requirement for nodal stations is inescapable and the city planners will have to find ways for providing the land.

23. While deciding the location of the exchange terminals it is necessary for the urban planners to carefully study the secondary environmental effects on the areas in the vicinity of the terminals and suitably provide for such growth in their

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plan. The activities at the major exchange terminals will undoubtedly significantly affect the character of the activities in their vicinity and unless detailed studies in this regard are simultaneously undertaken, the urban plan may prove inadequate in the years to come. This is an important aspect of interaction of the urban form and the public transport system and would need serious consideration by the urban planners.

24. The integration of the intracity bus system with the interstate bus operation and the Mass Rapid Transit System if one is contemplated, is also of paramount importance. In Delhi, for instance, there is at present only one Interstate Bus Terminal near Kashmere Gate. In the Land Use Master Plan, three more Interstate Bus Terminals at Karol Bagh, at Mathura Road near C.R.R.I. and at Shahdra have been provided. In the contrext of the new system of operations, it will be appropriate to coordinate the Interstate operations with the Intracity operations at the peripheral exchange terminals. It has been proposed that the four peripheral exfhange terminals, namely, Kashmere Gate, Shrinivaspuri, Dhaula Kuan and Punjabi Bagh should function as combined intracity and interstate exchange terminal thereby providing efficient city exchange services to the Interstate passengers. This has been accepted by the Town & Country Planning Organisation and is being incorporated in the Land Use Master Plan. Though it will be quite some years before the Mass Rapid Transit System Corridors are established in Delhi, it is extremely important that the bus exchange terminals are designed in such a way that they integrate fully with the Rapid Transit Corridors whenever they come into being. Detailed studies are already in the hand to integrate the bus terminals with the Rapid Transit Terminals. For example, the Kashmere Gate, Shrinivaspuri, Dhaula Kuan, Punjabi Bagh and Kendriya Terminal and Moti Nagar authorities have already taken up making suitable adjustments in location of their stations so that the integration is complete. When the M.R.T.S. corridors will be pulled out and deployed for feeding traffic into the MRTS Corridors thereby establishing complete coordination between the two systems. It need hardly be emphasized that similar comprehensive studies need to be taken for every city with a view to establish forms which would meet the short term objectives and, at the same time, fully take care of the long term requirements.

25. Recognizing the importance of the public transport system for urban living, the need for bus priority measures in the matter of use of the road carriage way and parking areas has now been fully accepted in the West, both at the policy and at the implementation level. In the developing countries, the significance of these measures is, however, still not fully appreciated. The policy makers, who, by and large, are still car users, give primary consideration to car-ownly zones and car parks and whereas extensive zones (like Connaught Place inner circle) are reserved for cars and extensive car parks are

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developed in strategic areas, requirement of the buses for movement and parking are largely ignored. Unless the entire thinking on the subject is immediately reoriented and the requirements of the bus system are fully integrated in urban planning, investments may go in the wrong places and it may become extremely difficult and expensive to undertake corrective measures at a later date. The fast rate of urban growth has put tremendous pressure on the existing roads and related facilities resulting in congestion, low speeds and traffic hazards and whereas measures are taken to construct new roads or widen the existing ones, little thought is given to achieve better utilization of the existing facilities. The absence of bus parking and trun around facilities in residential areas and business complexes and inadequacy of bus bays and recesses on the city roads results in the buses using the road carriageways for turning around parking and loading and unloading passengers thereby substantially reducing the effective capacity of the available road spaces. In most cities, a large number of new, residential areas and business centes have come up during the recent years but neither the authorities who have developed these areas nor local bodies have considered, it their facilities in these areas Likewise, the demand for services in old residential and busine areas, University Campuses etc. is increasing everyday, but no effort is being made to provide bus parking and turn around facilities resulting in delays, traffic confusion and hazards and poor operations. The development of bus bays and recesses on all principal roads particularly those which are being developed as traffic channels for bus operation so as to improve the effective capacity of the available road space needs to be taken up immediately. It is improtant that the local bodies other agencies connected with the subject seriously address the selves to this important matter.

26. Bus priority measures also essentially aim at better utilization of the available facilities. There are basically, four types of bus priority schemes :

(a) "With flow bus only" lanes (b) 'Contra flow' bus lanes; (c) Other bus priority measures such as precedence for buses at intersections and by diversion of runs from congested routes toless congested routes and (d) by traffic management schemes w or without bus priority measures. The c oice of action is evidently in favour of an increase in the mobility by public mass transport media instead of catering for the private automobile and the other small public transport facilities whic oly in large numbers, despite their inefficiency to move people The bus movements must be afforded substantial priorities even to the extent that would result in gently coersing nodal choice in favour of bus travel. Bus travel speeds have a profound effect on the operations, a fact which is often not fu appreciated. Low speeds results in wastage of fuel and deteror of the bus machinery due to frequent use of b akes and speed

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accelerations and wastage of carrying capacity. It has been estimated that in the United Kingdom if it was possible to increase the speed of all motorized vehicles by even 5 miles per hour by making available lesser congested road network, there would be a saving of £450 million per year. If such an evaluation of losses, incurred by the Delhi Transport Corporation, is made, it will also work up to a tidy sum. If the discretionary traffic regulations and instructions, which are, at present, applied to buses in common with other vehicles, were relaxed for buses only, while on the movement of all other vehicles some restrictions are put, there will be substantial increase in the speed of bus traffic operations which would reduce the operating costs of buses and will also result in an improved bus service. An indepth feasibility study of the bus priority measure which can be introduced needs to be taken up by the urban planner in collaboration with the bus company management and a time bound implementation plan drawn up. For the first time since its establishment, the Delhi Transport Corporation has a few months back, set up a trafficengineering cell and has initiated work in this direction. It will, however, need considerable support and positive responses from the civic bodies, urban planners, land authorities and city administration for any thing worthwhile to emerge.

THE FUTURE NEEDS

27. The fact rate of urban growth will always pose a serious challenge to the public transport system. Unless ~~serious~~ attention ~~challenge to the public transport system~~ is immedirected directed to designing and implementing an optimal system and efforts are made on a continuing basis to build up adequate carrying capacities, the public transport system may never be able to keep pace with the growing demand. The urban planners and traffic engineers will have to specially adress themselves to the needs of the public transport system and design forms which would lead to the most efficient use of the available bus fleet. Surface and underground rapid transit system are generally advocated for Metropolitan cities. The investments required for such projects are, however,, substantial and the engineering problems are so complex that these projects offer little hope in the near future. Furthermore, the smaller cities can hardly afford such heavy investments and will have to depend entirely on the bus system for their transportation needs.

28. A new concept in public transportation is the designing of separate tracks for bus operation. These tracks should not be confused with bus lanes. The bus tracks are completely segregated by railings and only ticketed passengers are permitted entry at the leading points. The tracks, like railway tracks, are closed to pedestrains and any other modes of transport. The advantage in this arrangement is that the bus gets free and

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uninterrupted movement thereby considerably improving its speed, reducing chances of accidents and enabling very hig frequencies to be provided. While operating on normal roads, frequencies lower than 2 to 3 minutes become extremely difficult to provide since traffic bottlenecks lead to heavy bunching of buses. In track operation, on the other hand, frequencies as low as half a minute can be provided thereby substantially increasing the total carrying capacity of the track surface. Such bustracks would be most siuted along those corridors, where the trasffic load is too high for the conventional bus system and too less to justify a high capacity Rapid Transit System. Designing such bus tracks in the urban plan and their integration with the remaining bus system through exchange terminals and other concepts discussed earlier, holds considerable promise for both the Metropolitan and ~~smi~~ smaller cities. Such scientific planning for an optimal bus system seems to be the only solution for meeting the future needs.

CENTRAL TERMINAL PROJECTED LOADS

No. of buses calling at the Terminal per day

1. No. of buses calling at the Terminal per day	345
2. No. of bus trips calling at the Terminal per day.	2400
3. No. of buses calling per hour (peak)	300
(a) From North Avenue	60
(b) From Pandit Pant Marg	120
(c) From Rajya Sabha Marg	120
4. No. of buses loading at any time	60
5. No. of buses idle parking at any time	30
6. No. of passengers calling at the Terminal per hour	25000
7. Maximum number of passengers in the terminal at any give time.	2500
8. Area required for circulation and parking buses	5½ acres
9. Area required for circulation of passengers	6 acres
10. Area for auxilary facilities e.g. taxies, scooters, etc.	2½ acres
11. Total area	14 acres

TABLE - 1

OPERATIONAL STATISTICS

(December, 1974).

	Mudrika	Sugam	Feeder	Old Services
1. Average number of buses on road.	54	118	159	893
2. Kilometers per bus daily	333	220	214	189
3. Passengers per bus daily	1537	1348	1019	1021
4. Revenue per bus daily (Rs.)	444	365	277	222
5. Revenue per bus - k.m. (paise)	136	162	130	117

Note : It is evident that Mudrika Seva operates maximum kilometers, carries maximum number of passengers and earn highest revenue per bus per day. Sugam seva is next to Mudrika. Figures for the old services shows the clear under-utilization of the bus fleet.

" TRENDS IN URBAN TRANSPORTATION".

by

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In the past, the urban scene used to take hundreds of years to change appreciably. Naturally, such a change was slow, gradual and leisurely. But, of late, with every passi decade, the changes are beyond recognition. Such is the enormity of the problem and the issues that urbanization has created, it its wake.

Two of the main causes of urban chaos all over the worl have been unchannelised industrialisation and uncontrolled migration.

According to some demographers, by the turn of this century, India's urban population may almost treble. In fact, while the increase in our total population since independen has been about 100%(which itself is abnormal) the increase in our urban population has been almost 250%.

By 1975, four of our cities may have the distinction (!) of being listed amongst the first 50 cities of the worl And, Bombay and Calcutta may be seventh and eighth on that list.

In 1950, of the total world population of 2.5 billions, only one out of every four persons lived in the cities. Bu by 1971, the world population was 3.6 billion and, one out c every three lived in cities and towns. And, by the turn of t century, the proportion will probably be: one out every two persons. The world population by then may be expected to touch 7.5 billions. And, the urban populations in developir countries like ours are also rapidly catching up with those in developed countries.

The urban population of India according to 1971 census was 109 millions(20% of the total) whereas in 1951 the urban population was 62 million(17.3% of the total) out of 357 mil

The following table gives the growth of urban population in India since 1901.

ensus ear.	No. of Towns	Total urban population in millions	% of urban population to total population.
901	1888	25.8	10.8
911	1875	25.9	10.3
921	2012	28.1	11.2
931	2145	33.5	12.0
941	2329	44.2	13.8
961	2461	78.9	18.0
971	2641	109.1	19.8

It is worthwhile to note that the growth rate of popula-tion among the major cities increase at a faster rate i.e. between 22.5 and 63.0%.

	Population in 1971(in million)	Growth rate 1961-71.
Calcutta	7.0	22.5
Greater Bombay	6.0	43.8
Delhi	3.6	54.6
Madras	3.2	63.0
Hyderabad	1.8	43.3
Ahmedabad	1.7	44.4
Bangalore	1.6	37.8
Kanpur	1.3	31.3
Poona	1.1	43.5

Such an ever-increasing population naturally results in increased population density. Most of our towns and cities have not been planned properly, especially with respe their increasing demands for transportation. For example, in Bombay, the Fort area and the adjoining Central Business District account for as much as 70% of the total employment in the island. This naturally forces a unidirectional flow of traffic in the North-South direction in the mornings and South-North in the evenings. Even as at present, the centr and western Railways together carry nearly 3 million passen per day and the BEST bus another 2.9 million passengers.

Existing Conditions:

Except perhaps Bombay, in the other cities of our count mass transportation systems are yet to establish themselves It is in this context, worthwhile to note, that in cities li Tokyo more than 90% of total trips are performed only by ma transportation systems.

City	Year	% of total trips performed in mass transportation systems.
Bombay	1973	78
Delhi	1972	41
Madras	1971	53
Bangalore	1966	38.2
Hong Kong	1965	76.2
Singapore	1968	40.4
Tokyo	1962	92.4

In urban India, we face a peculiar problem on our roads due to the mixed flow consisting of hand drawn and bullock carts, horse drawn carriages, bicycles and fast moving automobiles, which unenvious situation the planners in Developed Countries did not have to confront with and solve.

Also, in our present socio-economic conditions, it is very difficult to under-estimate the role likely tobe played by bicycles in our urban transportation scene. This is evident from the following table which gives the distribution of trips, mode-wise, for the Delhi urban area in 1957 and 1961.

Distribution of Trips - Mode wise (Delhi Urban area)

	1957 in %	1961 in %
Bicycle	36	28.01
Mass Transport	22.9	40.80
Private Cars	11.1	23.77
Private Bus	12.2	5.23
Others	17.8	2.19

Even though the percentage of bicycle trips may appear to have decreased between 1957 and 1961 from 36 to 28.01, their actual number have phenomentally increased from 1.47 lakhs in 1957 to 6.5 lakhs in 1972(vide table below).

Number of Vehicles on Road in Urban Delhi.

Type	Number of Vehicles 1957	 1972	 % increased
Cars	10281	68081	568
Motor Scooters	5715	128337	2146
Taxi	1391	4483	223
Auto Rickshaws	1555	[illegible]	701
Good Vehicles	2191	16355	646
Buses	1023	3768	268
Others	543	852	57
Cycles	1.47 lakhs	6.5 lakhs	343

In Calcutta, there are about 450 trains, 950 buses, 85000 private cars, 16,000 lorries and 5000 tempos.

In Bombay, there are about 93,000 private cars accountin for 150,000 trips and 1300 BEST buses accounting for 2.2 million trips per day.

In 1967, 93 DTU buses carried 7.5 lakhs passenger per day And, on the whole, there are over 500,000 cars in this country

The population density is as high as 22,759 person/sq.km in Calcutta, 9597 person/sq.km. in greater Bombay and 7314 person/sq.km. in Delhi. Such steadily increasing densities naturally constitute one of the main reasons for the continuing increase of trips on the important urban arterials. The situation is bound to become worse in future if the growth of our urban areas is not somehow got checked or channelised.

The Present Accident Situation

In Delhi, for every 11 road accidents, one could be fatal according to present statistics whereas it is one for every 45 in Bombay. In numbers, there were 576 road deaths in 1969 in Bombay, 433 in Delhi and 184 in Madras. In Bombay there ar 2 fatal accidents a day on suburban trains alone. The acciden rate is bound to increase further, as we go in for more and more of vehicles, that too under the present mixed traffic conditions.

Bombay's suburban services are now catering to about 2.5 million passengers per day.

The passengers carried by our suburban train in 1950 and 1970 are:

	1950 No.of Trains	Passengers Carried	1970 No.of Trains.	Passenger
Bombay	741	290953	1243	850340
Calcutta	300	81013	660	270363
Madras.	258	40182	328	98860

The following table gives the importance of bus transport in metropolitan cities:-

City	Route length in kms.	Passengers Carried daily	% of population carried
		million	
London	6440	7.5	73
Paris	1541	2.5	38
Berlin	2882	2.3	104
New York	876	1.2	7
Tokyo	9660	3.5	23
Bombay	1172	1.5	44

In a recent cost analysis made for Bombay, it is revealed that the cost per person trip by bus is about 20 paise, whereas it is Rs.2.40 per person trip by car. This unfavourable cost factor which is quite likely to worsen further due to the deepening international oil crisis, is bound to discourage the use of private automobiles in our urban areas. Further, almost all our metropolitan roads are over-crowded even at the present vehicle population level and the situation is likely to deteriorate still further, especially with the increase in travel, contributed by the latest trends in mobility and civilisation. We should also, in this connection, take note of the fact that at present only 5.1% of land in Calcutta, 10.64% of land in Bombay and 20.4% of land in Madras are utilised for transportation and allied purposes, which is far below the desirable 1/3 of the total urban space. This is also an important factor therefore, which will have a restraining influence on any unrestricted private travel.

The transportation problems, which we face today in our urban areas, are, to a sizeable extent, due to lack of sufficient co-ordination between our land-use and transportation activities. Also, till recent times, public transport systems did not receive the encouragement

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they rightly and richly deserved.

At least before it is too late, we must take lessons from well developed or industrialised countries in Europe and America. The capacities of their Express-ways, Motor-ways, Free-way and Auto Bahns have already been exceeded due to the abnormal increase in the number of private automobiles. Consequently, in U.S.A. they have been started thinking in terms of laying roads by linking the roofs of their sky scrapers. The industrialised countries are thus finding themselves unable to satisfy the travel demands of the private vehicles which have been allowed to grow in numbers, almost unchecked so far. In China, on the other hand, only the Bicycle is found to be the main mode of commuter transport in urban areas. This aprt from other benefits, also helps them to very great extent to save the much-valued and much-needed oil.

It therefore appears that for a balanced transportation development of our urban areas, we must have a happy blend of both the above systems. Land-use development must therefore be started to be controlled by appropriate and competent authorities in almost all the major cities and towns of India, right from now onwards, if we are to have any sanity and order in our future urban traffice. They should be allowed to grow only in a pre-planned and healthy manner. The location of important traffice generating institutions should be intelligently foreseen and ideal transportation facilities planned in time. This may perhaps mean that in some special cases, even facilities like mono-rail system and vertical take-off and landing Air craft systems may have to be thought of to help to solve some of the Urban Transport problems of our country roundabout 2000 A.D.

But reverting back to the situation of today, our main taks is to serve our urban centres (vide table), with the available and anticipated mass Transport media and facilities.

Mass Transportation Trips in Metropolitan Cities

Name of city (1)	Year (2)	% of total trips performed in mass transportation systems. (3)
Bombay	1973	78
Delhi	1972	41

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(1)	(2)	(3)
Madras	1971	53
Bangalore	1966	38.2
Hangkong	1965	76.2
Singapore	1968	40.4
Tokyo	1962	92.4

Comparing, in this context, the existing restricted land avaialble for transportation and allied activities in our urban centres and also the requirement of space for different mode of transport, there cannot be any argument against encouraging mass transport systems and discouraging transportation by privately owned or personal vehicles of transport to the extent possible.

Area required in Sq. m. per person in motion.

Mode of transport	Average speed km/hr.	Area required per person in sq.m.
Pedestrain	4.7	0.7
Pedal cycle	12	8.0
Motor cycle	12	17.5
Car	12	40.0
Car on Express Way	40	47.0
Bus (55 seats)	10	4.5
Train (150 seats)	10	2.0
Train (250 seats)	10	1.5
Underground Railway	25	2.5

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Practical capacities of different modes of transport.

1.	Passengers in cars and taxis on surface streets.	1500/hour/lane
2.	Passengers in buses on surface streets (double deckers & articulated trailers)	9000/hour/lane
3.	Passengers in electric street-cars on surface streets free of animal drawn traffic	13,500/hour per pair of trakcks.
4.	Passengers in surface suburban trains with 9 coach rakes (3 to 4 minutes frquency)	20,000/hour/per pair of trakc.
5.	Passengers in surface suburban trains with 12 coach rakes.	35,000/hour/per pair of tracks.
6.	Passengers in grade separated Rapid Transit with a head way of 2-2½ minutes.	40,000/hour per pair of tracks.

The following table gives the per capita daily trips in selected cities (170).

London	1.54
Chicago	1.92
Melbourne	1.56
Bombay	0.80

Estimated trips/year/person for 1991 are:

Madras	380
Calcutta	391

The number of trips/person/day in our metropolitan cities is likely to go above 1 by 1990. For example, in Madras Metropolitan area it is estimated that there would be 77,14,774 trips by 1991. Similar increase could reasonably expected in all the

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metropolitan areas of the country. Such high trips can be met with tcerably satisfactorily only if we go in for a suitable modal split of say 80:20. This would naturally lead us on to choosing a particular type or types of systems required to serve our specific future travel requirements. The table furnished above on the "Practical capacities of different mode of transport" may partially help us in deciding the appropriate systems for our future.

SOME OF THE NEW SYSTEMS THAT MAY BE THOUGHT OF IR THIS CONTEXT FOR MEETING OUR URBAN TRANSPORTATION REQUIREMENT OF 2000 A.D.

1. Dial - o ride: This is a demand estimated system. Small buses can follow flexible rooting instructions radioed to the driver from a computerized scheduling point. If this system is brought in, the use of private vehicles may decrease considerably. This system would perhaps be more suitable for our lower-density urban areas than conventional transit.

2. Alden Capsule Transit Systems: It is a rubber-tired vehicle operating in a tracked guide way at cruise speeds of 15-40 miles per hour and maximum speed of 60, capacity of 15 persons and operating head way of 1.6 seconds. This may perhaps be suitable for slightly bigger urban areas than the above.

3. Mini rail: This vehicle rides on a double I beam, powered by electricity collected from the rail. They carry 4 to 12 passengers each and have cruising speeds of 12 to 20 miles per hour. This may be able to meet the needs of our medium sized towns.

4. Sky car Transivator Systems: This is a pheumatic tired vehicle suspended from a steel beam mono-rail with a cruising speed of 15 miles/hour and 12 passengers.capacity operating on 5 second headways. This may be found suitable four our high density areas.

5. Vehicle Distribution System:- The vehicle rides on rubber tyres over a concrete guideway, and has a capacity of rom 25 to 35 persons, headway of 40 to 60 seconds and cruising speeds of 45 miles/hour. This may have better application for localized guidways in our high dnesity areas of the future.

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VTOL/STOL Air bus service:

Vertical and short take-off and landing systems are possible in the near future for intra-urban travel with stage lengths between 20 and 50 miles.

The trends of future development in Urban Bus Transportation may be under these groups:

1. Computerised scheduling for optimum utilization
2. Preferential treatment of buses at traffic signals in urban areas.
3. Specialised door-to-door service
4. Mini bus operation
5. Reserved bus right-of-way.

Cost analysis:

The total number of passenger trips per day in Bombay city is around 8 millions. Of these, 10% are made in nearly 100,000 cars and roughly 40% of trips each are carried by buses and trains. A car is driven for more than 10,000 miles a year and a bus is operated for less than 55,000 miles per year. Even assuming a favourable (average) fuel mileage for cars of 5 miles/litre of petrol and an unfavourable average mileage of 2 miles/litre of diesel for buses the fuel consumed in Bombay by buses and private cars works out to 200 million litres of petrol per year for cars and 50 million litres of diesel per year for buses. This shows that as such as 200 million litres of oil is spent for only 10% of trips whereas only 50 million litres of oil is spent for as much as 40% of trips. This clearly shows how much of the valuable fureign exchange could be saved by our nation, if the trips are encouraged to be made more and more by public transport. Therefore, in future, the trend should be to discourage private transport and encourage public transport, considering the amount of foreign exchange that could be saved and the additional capacity available.

TRANSPORTATION REQUIREMENTS OF OUR URBAN AREAS IN TERMS OF LAND USE PLANNING POLICY.

Traffic is a function of land-use. Once a particular type or types of land-use develop within a city, it would be extremely difficult to change the

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same substantially, at a later date. And, unplanned organic growth of our cities will lead inevitably to irreparable loss to the community. But unfortunately, we in this country, still do not enforce effective controls in areas which are lying within as well as just outside our city limits, thus allowing the cities and their suburbs to grow in an unplanned and arbitrary manner, most of the ribbon type and therefore it is high time that there is effective and continual control over urban and pheripheral developments. Within the cities themselves, due to such lack of control over land-use, undesirable developments take place leading to concentration of trips along a few major arterials during certain specific periods. Allowing such disorderly growth is bound to result in the need for heavy public investments for traffic management measures at not too distant a date. Therefore any policy regarding the future development of our urban and suburban areas should even from now itself, be directed towards adopting a balanced land-use form, which should envisage for shorter and minimum number of essential trips only. And, especially while planning new cities and towns the types of transportation systems that are to be used in future should be considered in depth and their possible requirements must be taken into careful account. It may perhaps be pertinent in this connection to suggest the setting up of a competent planning cell to take up effectively Traffic and Transporation Planning studies for all urban cetnres in our country which exceed a population of one lakh.

OUR URBAN TRANSPORTATION REQUIREMENTS BY 2000

1. Roads: There were 89000 Km of road in Urban areas in 70-71 serving a population of 109.1 millions. This works out to 815 Km of road per million population. Even though it is conceded here that the road length availabke in an urban area annot be directly related to the population, this provides a directly related to the population, this provides a tangible guide for future development in the road sector. The total population of the country is likely to be doubled by the end of this century. Assuming that urban population becomes equal to rural population, there would be approximately 500 million living in urban areas. Therefore by 2000, we may have to have about 4,00,000 Km. of roads in the urban areas alone.

ii. Railways: Besides being the largest undertaking, the railways are regarded as the lifeline of the country's surface transport system. We have a fairly good rail network in this country connecting various urban centres. However, there are still many urban centres which require rail connections for economic growth. Many small urban centres which exist today, may develop and become important in future, and such places have to be connected with rail network.

Suburban train services require greater attention in major and metropolitna cities. Existing suburban services in Madras, Bombay and Calcutta though inadequate, have proved to be of great service to the commuters. Due to non existence of such services in Delhi, Ahemdabad, Hyderabad and Bangalore the road system has to bear a disproportionately larger burden of the traffic. It is needless to explain the advantages of train services in such urban areas over conventional road facilities. Therefore, it is desirable to undertake studies, right from now onwards in this direction to determine which of the major cities are to be provided with suburban train facilities on a priority basis.

iii) Airways: The existing network of services can perhaps be taken as relatively adequate in relation to trunk routes. They are operated with a comparatively greater efficiency and provide a better level of service than the regional routes. Economic development in a number of regions could however be accelerated if more adequate air services are provided by 2000.

iv) Water Transport:- India have a total length of more than 13000 Km of inland waterways, of which only a fifth is navigable by steamers. Inland water transport services are now mainly operated at present only in Assam, West Bengal and Kerala. But, inland water transport could be improved and early efforts should therefore be made in this direction by the Centre which happens to have exlcusive legislative jurisdiction in respect of navigation, by indroducing and encouraging mechanically prefelled vessels on our inland waterways. In Kerala, country boats are still predominantly used. It is suggested that if the system is improved, it may prove to be one of the important transportation systems providing facilities for inter-city movement at an economic rate in regions like Kerala, Assam and West

Bengal. Efforts can also be made to develop coastal navigation in the West and East, to provide good transportation facilities to coastal towns. This sector has not been developed fully. As we have a long coastal line from Calcutta to Bombay, it would be a great boon if inland coastal shipping is developed to the optimum extent. A good coastal network can also incidentally, reduce to a large extent, the load on rail and road systems. Therefore this vital field requires immediate attention, so as to be able to become a sizeable inter-urban transportation facility by 2000.

v. Pipeline Transportation: In the United States, pipelines carry more than 17% of the total intercity freight movement. Crude oil from Urals moves by pipe line over a distance of 4500 Km. through Poland and East Germany to Hungary and Czechoslavakia. In India, at present, petroleum products are mainly transported by railways. It is hoped that if pipe lines are developed they will have a significant role in India in the near future for intercity transportation of petrochemical products. Also, if we encourage pipe-line transportation, they this may lead to a release of the much-needed rail and road capacity to a considerable extent for intercity transportation of other goods and passengers.

Pipe line transport system may also prove to be economical and useful to transport our coal and mineral products as well.

Our requirements in terms of buses, cars, scooters bicycles:

The number of motor vehicles available in India, during 1969-79 under different categories is given below:-

Buses	90,246
Passenger Cars and Jeeps	555,083
Taxis	59,240
Motor Cycles & Auto-rickshaws	491,034
Trucks	327,471
Others	100,983
TOTAL:	16,24,059

The total number of motor vehicels per lakh of population works out to 295 in India whereas this is 25744 in case of Japan and 55699 in case of USA. We cannot hope to reach the level of Western countries even by 2000. Further the increase in number of vehicles are controlled mainly by (i) Government Policy towards manufacture of vehicles (ii) Oil price (iii) Economic level of the community. In the absence of any clear picture, a conservative estimate is made. The estimated number of major vehicles by 2000 in urban areas would be 80 lakhs on the assumption that about 80% of the present motor vehicles are operated from or to the existing urban centres (ii) The urban population would become almost trable by 2000. (iii) The vehicle ownership would almost double that of the existing.

$$= 0.8 \times 1624059 \times 3 \times 2$$

$$= 1624069 \times 4.8$$

$$= 8100000 \text{ or say } 80,00,000$$

The existing ratio amon the different type of vehicle is:

Motor cycle and autorickshws	Passengers Cars & Jeeps	Taxis	Buses	Trucks	Others
0.302	0.342	0.036	0.055	0.201	0.061

At present, for every 27.73 Motor vehicles, we have 3.4 Motor cycles & autorickshaws; 9.5 passenger cars and jeeps, 1.0 Taxi, 1.53 buses, 5.6 Trucks and 1.7 of other type.

We see people going in for more and more of Motor cycles and autorickshaws nowadays. Similarly, the importance of bus transportation is also increasing day by day, thanks to nationalisation of bus operation and increase of oil cost. Therefore, further approxmimation can be made by giving increased weightage of 2.5 for Motor Cycles and Scooter, 2 for buses, and 1.5 for trucks. The ratio among the different types of

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Vehciles would then be 21:9.5 1.0:3.06 8.4: 1.7 i.e. for every 44.66 of Motor vehical in India by 2000, there may be 21 motor cycles and autorickshaws, 9.5 passanger cars and jeeps, 1 taxi, 3.06 buses, 8.4 trucks and 1.7 of other types. Therefore by 2000, the number of different types of vehicals expected would be

Motor cycles & autorickshaws	38 lakhs
Passenger cars and jeeps	17 lakhs
Taxis	2 lakhs
Bus	5 lakhs
Trucks	15 laksh
Others	3 lakhs
	80 lakhs

Bicycle: Bicycles are bound to play and important role in urban transportation in countryparticularly since they have proved to be quite a useful and economic mode of transportation in our urban centres, particularly for work trips and school trips. Even in Western countries cycles have started gaining in importance. Considering our economic conditions as well as the present and future crisis for energy, bicycles would definitely play an important role. To bring out the importance of bicycles in our urban centres, it is desirable to look into the situation at Delhi. About 28% of total trips there were made in bicycles during 1969. In Delhi itself the number of bicycles increased from 1.47 lakhs to 6.5 lakhs within a period of 5 years (1967-72). Besides, bicycles will definitely play a positive role even in small urban centres. It might therefore be safe to assume that there would be a requirement of one bicycle for every urban family by 2000 and this comes to 100 million bicycles.

By the end of this century, therefore, it can be expected that there would be approximately 80 lakhs of motor vehicles and 1000 lakhs of bicycles in the urban areas of this country.

Our requirements in terms of manpower like engineers drivers, automechanics

The traffic management is becoming a problem. We do not have adequate staff trained on this line.

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At present, most of the traffic improvements are carried out only by ordinary Civil Engineers and non-technical police officers. A large number of traffic improvements have got to be made in our urban areas and the days are not far to go in for linking of signals, use of television, helicopters, computers and other sophisticated devices in controlling traffic in our urban centres. All these speak eloquently in favour of more efforts from us to train the required technical and professional personnel.

Engineers:- The requirements regarding traffic and transportation Engineers and technicians could be taken at the modest rate of say 1 for every 100,000 of urban population. This would mean that we may require about 5000 traffic and transportation engineers and technicians by 2000 A.D. At present the total number of trained engineers coming out from all our institutions may not exceed 100 in an year. Therefore more facilities should be provided for at once in our institutions.

Drivers:- The number of drivers that might be required under different types of vehicles would be as follows:-

i) Motor Cycles & Autorickshaws:- The projected number of vehicles is 38 lakhs. Half of this may be roughly assumed to be privately owned. Therefore, there may be 19 lakhs of these vehicles. Each vehicle may require 2 drivers and therefore the requirements may be fixed at 38 lakhs.

ii) Passenger Cars and Jeeps:- The projected number of total vehicles is 17 lakhs. Assuming jeeps to roughly form one third of the total, there would be about 5 lakhs of jeeps. Assuming one driver for every jeep the requirement of drivers for jeeps would be 5 lakhs.

iii) Taxis:-The projected number of vehicles is 2 lakhs. Assuming 2 drivers for each taxi, the requirement would be a minimum of 4 lakhs of drivers.

iv) Buses:- The projected number of buses is 5 lakhs. Assuming 2 drivers for each bus the reqirement would be a minum of 10 lakhs of drivers.

v) Trucks:- The projected number of trucks is 15 lakhs. Assuming 2 drivers for each truck the requirement would be a minimum of 30 lakhs of drivers.

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vi. Other types of vehicles: The projected number if 3 lakhs. Assuming 1 driver for each vehicle, the requirement of drivers would be 3 lakhs.

Therefore, from the foregoing discussions, it is clear that the total requirement of drivers by 2000 A.D. would be 90 lakhs minimum (=38 +5+4+10+3).

Our requirements in terms of laws, regulations, rules, etc.

Training of such a large number of personnel requires huge investments from the Government. At present there is not a single institute of the required studies for scientific training in the country to train drivers. The time has come to educate our drivers on the traffic laws and regulations so as to control the increasing trend of road accidents. Many lives are lost every day on roads due to careless driving by our drivers. If any one undertakes the economic loss to the nation due to such accidents, it would definitely be a baffling figure. Urban transportation cannot be improved effectively unless we train the drivers who are controlling the vehicles. Besides these, such Driver Testing and Training Institutes shoul offer facilities for the private drivers also to get the necessary training. In this connection it is to be appreciated that the Government of Tamil Nadu have initiated action set up an Institute "Regional Institute of Road Transport" which incidentally will also provide special types of training facilties that may be required by the drivers. The Institute will also effect considerable savings in fuel by scientific route planning for nationalised transport undertakings in the Region.

Police Man:- Traffic police play a vital role in urban transportation. They are the people who look after the enforcement aspects of traffic laws and rules. It is unfortunate that they are not provided with adequate facilities to learn the techniques that are needed to control the traffic in our cities. Still out-dated operational methods are adopted by them. It is no wonder therefore that the police units of even metropolitan cities, do not have suitable devices to correctly assess for instance, the speeds of the vehicles. It is therefore highly desirable that the police are also taught about the basic principles of Traffic Engineering. There is thus a need for training our traffic police in a scientific manner. Possibilities for creating a separate cadre of Traffic

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Wardens may also be thought of to assist our police and local authorities.

By 2000 A.D. Television will be a common item in most of the households, at least in urban areas, like radios and transistors of today. Therefore, the television can be easily made to become an effective medium for controlling the traffic as well as training the public and children. Imparting knowledge of traffic control to public through television, may therefore be carefully thought of, in this context. The Government must also supplement this by making laws to prescribe certain basic qualifications for the drivers, who have to understand and implement the instructions flashed by such sophisticated devices like the computerised television.

Our requirements in terms of publicity, public relations, prepananda, safety, education and education.

All our efforts may become futile unless public cooperation is readily forthcoming.

Early action should, therefore, be taken to implement immediately and effectively, the 164 proposals given by the study group appointed by the Government of India under the chairmanship of Sri Tulsidas Jadhar, M.P. on road safety.

Radio and Television should be fully and frequently utilised.

Traffic Education should also find a due place in School and College curriculums. Traffic Parks may be located in major urban centres for the benefit of public and children.

Out-dated traffic codes should be revised. Highway coda should be brought out in all regional languages.

Signs and signals should be standardised to avoid confusion.

Number plates in the vehicles should be standardised with respect to the size of latters and figures.

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CONCLUSION

Considering our economy as well as our vehicle-ownership ratio, and the rate of growth of population in our urban areas, there cannot be two arguements regarding the importance to be given for improving and developing our mass transportation facilitis. Thereforre, unless effective and whole-hearted measures are undertaken, right now, for a detailed analysis of the entire problem to work out more precise details regarding the quality and type of mass transportation facilities that are needed for the different urban areas of our country, we may be faced with acute problems involving prohibitive expenditure and complexities similar to the ones that are being experienced by the urban areas in developed countries.

It is further suggested that especially while planning either our new Towns or extensions to existing urban areas, due consideration should invariably be given to the type of mass transportation system that may prove ideal to particular situations of land-use, population, area, topography, income level, economic activity and industrial capabilities, so that better facilities can be provided at lesser cost, in the first instance itself, which would obviate the need for any costly and uphill task of restructuring our urban areas, fully or partly, at a later date.

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SOME PROBLEMS FOR RESEARCH ON AIR TRANSPORTATION IN FUTURE

P.N. MURTHY

Movement, interaction and interdependence are some features of the modern societies. We are like societi on skates. Man move to propagate ideas and facilities decision making apart from the need to roam around for relief and education. Materials move from place to place, region to region and country to country to keep the wheels of industry revolving. Whatever may be the advancement in scientific and technological innovation, there may not be a moment in history when everything remains at the same place and still the quality of life is maintained. The problem, therefore, is to minimizd the movement of men and materials for a given rate of progress. Progress is of course difficult to define in its totality. However, we shall limit ourselves here to the economic component of it. In the present context of human civilization since the state, which is the politcal organisation of the society, plays a great role in guiding and shaping the economy of the society, its business also becomes an integral part of the economic component, Transportation is an important part of such economic activity.

As pointed out earlier, the two major units to be transported are men and materials. If the motive of pleasure is eliminated, men travel to propagate ideas and facilitate decision making. Short distance commutation is, however, to sell, buy, engage in commerce, participate in production activity and to pursue their defined duties at determined points within a city. In ancient days a person used to accompany his goods to long distances, travelling months together, to sell in distant parts of the world. This is no longer necessary.

One of the most important things in the organisation of future society is communication of ideas. This links transportation with other types of communication like telephone, telex, television, radio etc. If we can arrange conference calls, television discussions, a large part of the motivation for physical travel can be dliminated. Research into this aspect of relationship of transport with communications should be undertaken.

Future cities are expected to have different land use pattern than at present for several reasons. Like in present day Kerala, cities may spread into vast regions linking several human settlements. Most of what we call

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now as intercity movement may become simple commutation in a region or subregion. An integral relationship will then be established between underground, surface and air commuter services. Research into this relationship is important. This will involve the estimation of traffic, the divsision between the three types and the type of vehicle in each case. In the case of air, one has to determine whether it is a rotating wing, VTOL or STOL or even a balloon. The resulting problems of pollution, energy consumption, investments in irfields have to be studied. A cost effective model should be established.

It is expected that short and long haul patterns will remain the same. Research into this has to be undertaken for traffic estimates, vehicle types, noise and pollution characteristics, etc.

Fare structure in all these cases is important. Air transport is one case where the fare per passenger mile has come down over the decades. Unlike other transport services, even though in absolute terms the fares are high, Some technology fare costing has to be done to determine whether this trend can be maintained.

In the case of cargo, physical travel is necessary. Raw materials, finished goods, food stuffs, mail, books and newspapers (cultural materials) are some of the cargo to be transported from place to place. This can be within a city and/or between the cities. Out of these, large sized products and materials cannot be carried by air. With miniaturisation taking place in electronics and increasing power packed into a unit of medicine, it should now be possible to lift a wide variety of manufactured goods including vegetables, seeds and seedlings by air. Research into the types of cargo to be carried by air is to be undertaken. This should consider journey times and packing methods also part from cost effectiveness.

Air cushion vehicle has great potential as an inland surface transport over areas separated by large marshy patch difficult terrains and also connected by waterways and river Research into this potential should be carried out. Once ago cost effectiveness is an important factor in the final confusion about its usefulness.

The basic idea behind this study should be to help the growth of economy to give the people a better quality of taking advantage of the availability of air space which is less congested. It is not necessary to use every modern technological innovation and discovery for its own sake unless it is absolutely essential to the growth.

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HOUSING

Housing: 2000 A.D. - A Long-range Perspective for India

1. Introduction

The series of technical studies conducted by the Operations Research Group in January 1975, under the title of "A Long-range Perspective for India", has attempted to provide some dimensions in the limitations to growth until the year 2000. The major issues and constraints concerned with population, economy, agriculture, housing, transportation, minerals and metals, water resources, and energy have been studied under respective subjects.

Of the various economic sectors, housing and construction is a major consumption sector wherein two-thirds of the gross domestic capital formation goes. The share of the residential sector in the total construction industry varies between 25 and 35 per cent. Yet, housing in India is inadequate and unsatisfactory in many ways. There is, thus, a need to study the present situation and project demands on this sector in the future.

The four major objectives of the study on "Housing: 2000 A.D." are to:

1) draw the attention of the public and private sectors on the prevailing housing conditions in India

2) focus attention on growing housing needs in the country

3) estimate the building materials, land and manpower requirements

4) identify critical areas where a radical change is needed to meet these needs.

The paper on housing thus attempts to put the housing problem in the country in its proper perspective, and examine some of the issues and constraints that are likely to beset the planners and decision-makers in their quest for solutions to this perplexing social and economic problem. Last but not the least, what this study hopes to achieve is to generate knowledge and awareness of what India is likely to confront in the next three decades on the urban and rural housing front and to provide an information base for laying a course of action that will preclude a serious aggravation of the problem.

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2. Prevailing Housing Situation: 1971

The 548 million people in the country live as 97 million families (households) and have for shelter 93 million houses (housing units). The housing situation in the country is not as bright as the rati of households to housing stock may seemingly suggest. In addition to the present shortage of four million houses in the country, about 19 million houses are far below the standard of habitation. Moreover, the increase in the household size from 4.9 persons in 1951, to 5.2 persons in 1961, to 5.7 persons in 1971, has, to some extent lessened the magnitude of housing shortage during the past two decades. Consequently the number of persons per house has increased from 5.6 in 1951 to 5.9 in 1971. Besides, the number of persons per room in India is twice as many as in a European Country. Four out of every five houses in rural India are without basic amenities such as water-taps, latrines and bathrooms. Thirteen per cen of the rural households reside in a structure built w permanent building materials, but surprisingly a mere five per cent live in rented houses. Despite the concentration of India's four-fifths households and housing stock in the rural sector, its housing needs been paid scant attention. For example, the Fourth Five Year Plan provides but less than one-fifth of the total plan outlay for rural housing. Added to this is rural poverty -- about 50 per cent of the rural households are in the low-income group (below Rs.100), and four out every five households earn belo two hundred rupees.

In comparison, urban households have better housing structures and easier access to basic amenities. Eve other urban household has a structure built with permanent and semi-permanent building materials, has basic amenities. About 50 per cent of the urban households live in rented houses. A majority of them are sheltered in just one-or two-room houses: thus, they unwittingly add to urban conjestion.

But, we are adding more number of babies to the population and less number of shelters to the housing stock, thereby the housing gap is widens from year t year. The gap between the decennial growth rate of households (+2.6 million) and that of housing stock (-5.3 million) between 1951-61 and 1961-71 is bound to create unprecedented pressure on housing in the country, if it is allowed to go unchecked.

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3. Housing: 1971-2000

Between 1971 and 2000, households are expected to increase anywhere between 102 and 124 millions. Contrary to the trend in the past, the household size during the coming three decades is observed to decrease from 5.7 in 1971 to 4.7 or 4.5 in 2000. The decreasing household size coupled with the increase in the per capital income may evidently means a spurt in the future housing needs. In computing housing needs, care has been taken to account for inter-action of related factors such as population, economy, completions, demolitions, vacancy rate, and available housing stock, under low and high growth rates.

India may reach a billion population mark just before the beginning of the next century. The available housing stock at that time is estimated to range between 126 million and 170 million housing units. Today, 105 households are trying to manage with 100 houses. In the year 2000, 153 households may live in the same number of houses under unfavourable growth rates of related factors. The housing situation under favourable growth rates is not likely to be so worse, i.e., there will be 120 households per 100 houses. In either case, in the context of housing, no far-reaching improvements are likely by the turn of the century. Two-thirds of the total house-holds are estimated to be without amenities. Further, 65 to 71 per cent of the housing stock is expected to consist of houses built with semi-pucca and katcha building materials.

Our urban households with basic amenities will be between 63 and 73 per cent. The rural scene may not change significantly -- 66 to 76 per cent of the rural households will have no basic amenities for their exclusive use. That is to say, two-thirds of the total house-holds in the country will be without exclusive basic amenities.

4. Desired Rate of Net Additions to Housing Stock

In order to meet the housing needs of the country, under favourable and unfavourable conditions of determining factors, the housing activity has to be greatly increased. The expected rate of completions (new houses) per 1000 population should be stepped 3.6 times durin 1971-81, 2.6 times during 1981-91 and 2.4 times during 1991-2000 under disfavourable conditions. Under favourable conditions, the desired rate of completions should be 3.1 and 1.7 times higher than the expected rates of completions during 1971-81 and 1981-91 respectively.

The decennial rate of completions in the developed countries of the world is observed to be between 80 and 120 per 1000 population. The United Nations has also recommended a decennial addition of 100 dwellings per 1000 population for Asian and Far Eastern Countries. Insofar as India is concerned even half as many completions as recommended by the U.N. will considerably ease the housing pressure in the country.

Allocation of additional funds to housing implies adjustment in other sectors of economy. Whether additional resources needed for the housing sector are to be diversified from the share of construction industry, or by increasing the share of construction industry in gross domestic capital formation will largely depend upon government policy and economic priorities of the nation. On hypothetical basis, it is estimated that the housing needs of the country ca be fully met if expenditure on the residential sector is raised from less than one-sixth to about one-third of the projected expenditure on the construction industry.

5. Criteria to Meet housing needs of Needy Households

Households that do not afford to own standard houses and those that, need subsidy in 2000 A.D., may range between 50 million to 92 million. Maximum paying capacity (MPC) of a household for a house, cost and type of structure, and housing standard prevailing in urban and rural areas are considered as major parameters in deciding households that do not afford to own standard houses. Households that do not affor a standard house, range from 13 million to 22 million in the urban areas, and 37 million to 70 million in the rural areas.

Four out of every five households that do not afford a house are concentrated in the two lowest income groups, i.e., below Rs.100, and Rs.101 to 200. This strengthens the hypothesis that housing deficit will roughly be equivalent to the households living in houses beyond their MPC, and these are the households that require housing subsides.

A subsidy ranging between Rs.335 billion to Rs.610 bil is required if all the above mentioned households (low- and middle-income groups) were to be provided with a standard R.C.C. house at rates prevailing in 1971. The enormity of required subsides under the present policy costs doubts about adherence to prevailing housing concepts and calls for a change. Permanency of structure, as a minimum acceptable

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general housing standard, need no longer be considered as sine qua non. Priority should be accorded to house masses specifically in low-income groups, in houses other than permanent but faily habitable. Ways and means should be explored to bring the unit cost in line with MFC of as large a proportion of the households as practicable. of the households as practicable. The cost of 335 square feet of thatched house, or 200 square feet of tiled house is approximately same. By enforcing revised standards (as to type and area of a standard house), households that do not afford a standard house are reduced to between 17 million and 45 million. Required subsidies will accordingly come down to anywhere between Rs.7 billion and Rs.20 billion during 1971 and 2000. In any eventuality, the cost of a house remains beyond the MFC of a household in the lowest income group.

Apparently, the use of indigenous building materials and local construction methods with improved technology can only bring more additions to the housing stock at lesser cost. The housing situation can be eased further if the problem can be tackled at local level with the help of needy households. This may broadly mean (a) an increased participation of local authorities as sponsors of housing schemes, and (b) capitalize on the ability of Indian masses to create habitable structures with readily available local building materials within the framework of a national housing policy. Experiences of the countries like Britain, Singapore, Hong Kong, Japan are the few finest examples for this type of course of action. It is worth mentioning that the Fifth Five Year Plan document on housing made a beginning with a greater government participation in the coming years.

6. Building Materials

Adding severity to an already preplexing problem is the likely shortage of key building materials. It is estimated that requirements of cement and steel may increase minimum 3 times and maximum 7 times by 2000 A.D. depending upon the growth of population and economy. To meet the rising demand of cement and steel in the construction industry, an annual growth rate ranging between 4 per cent and 7 per cent is called for. The annual demand for bricks in the construction industry in the year 2000 will vary between 78 billion and 162 billion. Annual requirements of timber in 2000 A.D is expected to increase between 4 and 8 times.

It is difficult to predict whether timber will be replaced by any other material, but shortage of primary spieces of timber may be felt. Local

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substitutes will either have to be found or developed to overcome scarcity of cement and steel. The lime industry which has suffered a long period of neglect may have tobe revived either in its conventional way or newly developed forms.

7. Land

The physical landscape of India is bound to undergo a major transformation by the year 2000 in view of constantly growing requirements of food and shelter for its multiplying millions. Total land requirements of the residential and non-residential sectors are estimat at 18.4 million to 21 million acres. This means that 4.2 million to 7 million acreas of additional land will be required only for new habitation centers.

Additional land requirements, when compared with India' total geographical area, look insignificant. But, a well-defined land-use policy is urgently needed especia for concentrated habitation centers which present concen trated habitation centers which present conflicts and imbalances as acute as dearth of land. Sporadic laws on land-use enacted by various local development author have hardly been adequate. These policies should creat a favourable atmosphere to construct more houses in concentrated habitation centers by removing constraints like high land prices, large holdings and speculation purchases.

8. Conclusion

"The cold calculations of input-output ratios has dominated post-war economic thinking in development economics. Housing, it was fact, called for a large input and yielded little output... There is no doubt that very generally the poor countries in their understandable eagerness to raise production levels in agriculture and industry rapidly, are putting too little emphasis on the need for production investments in human beings and directing too little attention to the need for raising labour efficiency."

The time is ripe to shun orthodox economic theory o non-touchable attitude on housing in preference to a balanced social and economic development. There is an i tive need to recognise housing as a necessity of life n only to food and clothing, an employment stimulant, and

/wise expenditure in terms of balanced growth.

9. Acknowledgements

This summary is based on the study carried out by the ORG Baroda, and their efforts are thankfully acknowledged.

TOWARD IDENTIFYING AREAS OF STUDY IN SOCIOLOGICAL ASPECTS OF HOUSING*

Of the considerable bulk of literature dealing with the areas of interest in sociological aspects of housing two publications are particularly worthy of mention as important sources to learn the scope of the subject of sociology of housing. The symposium "Social Policy and Social Research in Housing" (Merton, West, Jahoda and Selvin, 1951) presents articles which have laid the foundation to outline scope and suggest programme for systematic research in a few selected sectors of the wide field of housing sociology. Another source is the article "An Approach to the Sociology of Housing" (Vapnarsky, 1965) which provides a short bibliographic review of the valuable literature in the field and gives a general assessment of the position of the subject today. Publications of this category have by now shaped the nature and scope of housing sociology in countries such as the U.S.A., England, France and Scandinavia. And the trend of the literature has yielded the more recent tendency to distinguish within the general field of sociology of housing three wide areas of investigation and theory. These are (Vapnarsky, 1965) (a) analysis of social processes related to housing policy, (b) relations between housing and family life and (c) relations between housing and community. Vapnarsky's article provides an excellent summary of insights, the more important contributions achieved by sociologists to each of these areas of sociological interest in the field of housing. Particularly worthy of mention in this connection are the works of Catherine Bauer (1951), John P. Dean (1949), Stuart Chapin (1955), Richard Dewey, (1950), Festinger and others (1950), walter Gropius (1955), Reginald Isacs (1949), Leo Kuper (1950, 1951), Meyerson, Martin and Banfield (1955), Mogey (1956), U.N. Report on the World Social Situation (1957 and 1961), Svend Riemer (1955), Louis Wirth (1947).

In spite of the growth of sociology of housing in the developed countries the practical utility of this applied field has not achieved a commensurate level of acceptance and popularity. In a few countries there have been attempts to put sociological research to effective use but in the others the use of social sciences has been limited to statistical analysis of housing conditions and in some cases to the organization of social work in housing projects. There is, however, a tendency to vest sociologica studies with a significant stature and this is partly a consequence of the efforts of U.N.O. and the programmes of international technical aid and co-operation.

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*Paper contributed by Prof K.R. Unni of the School of Planning & Architecture, New Delhi-1.

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Sociology of housing continues to be in its infancy in India. The full scope of the field as we have noted has relevance in application to the Indian situation although th scale of priority of areas of interest for sociological study may vary. The urgency of sociological studies emerges from the fact that most planners and architects and other important decision makers carry their technical expertise acquired from the western countries and do not hav healthy insights into the numerous issues involved in handling any specific Indian situation. This is not surprising, for there exist similar conditions in countries such as Canada as James A Murray (1962) points out the gap between statistical generalizations and insights into family life and living and the social class distance between the designer of houses and the majority of clients. Further, it is doubtful if most of the findings available from the field of sociology of housing in the western countries permi of application in developing countries like India.

The Indian scene in each situation has to be treated as a product of long history and field work has to bring for the true character of what is existing to-day as house, neighbourhood, village, and settlement patterns, both at micro and macro levels in rural and urban areas. Such an effort, although not intended for the field of housing, has been made by sociologists in the course of their enquiries into the subjects of their study and research. Scattered in the pages of monographs and journals are good sociologica descriptions of physical phenomena of this category awaiting a judicious handling by sociologists to shape it all in a manner useful to the planner and the architect. To cite a few valuable examples of this kind of study - (a) Irawati Karve, in her paper on the Indian village stresses the need to study patterns of settlement as related to social groupin of family, kin and caste. She describes the existence of pols, residential arrangements housing families of large kin groups, in the cities of Baroda in the high caste areas of the old residential zones. Within a pol are khadkis which are generally two storeyed buildings accommodating fou households. The caste character of the pols has now become altered, but it requires to be studied how far such a layout is providing effective neighbourliness inspite of its altered social character. (b) T.N. Madan's (1965) descripti of a Kashmir village and the domestic architectural aspects in relation to social life presents dimensions to develop insights useful for village planning and rural housing. (c) A.C. Mayer's study (1959) of Caste and Kinship in centra India provides an understanding of relationship between distribution of social groups in space. (d) Oscar Lewis (195 describes the pattern of distribution of lineage segments and other kin groups and local factions in a village. Numerous studies of villages and towns today show a commendable coverage of the distribution of social groupings and certain kinds of activities in space (as distinct from the conventional maps of land use/surface utilization of the planner and the architect).

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We can thus find that in the very matter of understanding the broad social meanings attached to evolved pattern of distribution of space we need historical insights. It is even more important that in any other field of housing perspectives need to be built on firm foundations of knowledge of what exists as a matter of long evolution - the organic growth.

Recognition of the sociologists role today -

In the teaching courses covering the planning and housing fields sociology has yet to make its impact, and this is likely to get delayed for years to come for reasons which will be considered later. In the large schemes of metropolitan planning and in the preparation of master plans of cities the sociologist has become a member of a team of specialists usually getting much less importance than the economist, statistician and the urban geographer. And in nearly all such situations his work is under a sense of pressure to feed the final report writing with findings that will suit an immediate action programme of amelioration. Therefore, too often, his focii of investigation happen to be such subjects which the planner or architect would have done by himself. For a sociologist of some experience to devote to surveys of living and working conditions and of degree of residential overcrowding and the like matters would regard himself as 'underemployed' in a field that is rich for him to study with a view to giving findings of short-term and long reaching benefits to the planner.

In sum, then, the status of sociology of housing in India is, as noted, in an infancy of questionable health.

Areas of interest in the Indian situation today -

The main heads under which, in the situation obtaining in India, the subject of sociology of housing deserves to be conceived can be stated as -

(a) historical and socio-cultural perspectives

(b) sociological insights into pattern of current housing

(c) housing and social change

(d) analysis of social processes related to housing policy and administration.

In suggesting these broad areas each is calculated to cover a certain area of knowledge that can be utilized

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by a constructive planner or architect. These areas are indicated in outline below.

Historical and socio-cultural perspectives.

house and home; house as an expression of a way of life; non-spatial constituents of house; social meanings of house and its parts; house as a product of social and cultural factors; the idea that a house is a house only in the context of a cultural discipline; case studies of traditional houses from different parts of India; social aspects of residential setting in which home life is wholesome and enduring, (i.e. the traditional evolved neighbourhoods as seen in their 'organic growth'); study of contributions of sociologists/anthropologists on settlement pattern, houses, evolved neighbourhoods, owner-craftsmen relationships.

Sociological insights into current pattern of housin

The primacy of social factors in the client's choice of a house; the architect-client relationship.
relationship between housing and family life; terms and concepts regarding social units housed and dwelling units and their parts; functional description of house from the social point of view; psychological and social sources of residential satisfaction for the family; the problem of the lag between the expected "design determined" use of a house and its actual pattern of use by residents; attempts to analyse and explain this lag; the house and the developmental sequence of family and the shifts in need for space; the modern urban planned neighbourhoods and the extent of community life; stratification in such neighbourhoods.

Housing and social change.

relation between housing and community and examination of the theory and practice of neighbourhood planning and identifying its limitations and yet its desirability; socia stratification and the neighbourhood community the problem of how far changes in physical form can alter social forms and case studies dealin with this aspect of change;

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Processes related to housing policy.

> social factors/processes related to housing policy; orientations and training background of experts in the field; analysis of roles played by the different actors involved in the building process; architect, land developer, financier, government official, contractor, sub-contractor, craftsmen, materials manufacturer and distributor; and studies of attitudes of the public toward the problem of buying or renting a house; the place of housing management in organised large scale housing estates.

Some illustrations in the Indian contect -

The list of areas of interest presented above and the specific subjects make an extensive field. A few of these can be selected to illustrate how studies in India need to be done to reveal the realistic and crucial nature of the phenomena considered.

The concept of liveability in a house is usually framed in terms of activities in a house. As Murray (1962) notes, the catalogue of housing activities indicate a richness of the mixture - entertaining, drinking, play, recreation, child training, washing, dressing, sleeping, loving, care of the sick, etc. and doing nothing is well. And good domestic architecture is supremely dependent on an understanding of what individuals and families conceive of these activities and in what specific manner they carry out these". All these in the Indian context have their socially and culturally variant forms which can affect the standards of felt need for use of space.

As an example, the functional space called kitchen may mean different things to people in different parts of India. Even to the rapidly modernising urban sections the kitchen may become less important regarding needs of space due to gadgets, and as well, through the habit of eating meals from restaurants. And a kitchen for such people may be reduced to the need of that of a nook for cooking on a very limited scale, or, changes may favour the kitchen having a dining nook as the core of homely life. In villages near Delhi I found that the wall-less cooking nook is a more 'solid' kitchen to the house wife than a built up one with improved hearth. The degree of ritual purity of the cooking place and habits of avoidance of the place by members of the household and some 'kitchen-side manners' strictly observed make up for the image of the kitchen as

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conceived by the house wife. Similar social and cultural meanings are attached to different parts of a house (Unni, 1965) and several of such meanings find their manifestations in the urban homely life of the modernising people as well.

Studying the rural house mainly from the point of view of the actors involved, the households which occupy it, I found the need to redefine what is a rural house, what is a dwelling unit, and what is a courtyard, what neighbourhood means in the context and to hypothetically pose the problem that the social unit housed in not a household but a more flexible group larger than the household (Unni, 1965), (Saroj Kapoor (1965) in her study of an old sector of old De occupied by a well-to-do caste of business men has found tha similar perspectives become meaningful in certain contexts i an urban study. David Oakley (1965) has shown that village planning and housing has to be based on a thorough understanding of the meaning and function of the physical pattern from the micro level of the courtyard to the level of the village as a whole.

It is a matter of common observation in India that when a large joint family partitions into small ones or nuclear families they maintain a common house (a residential setting) with one main entrance, or, they may scatter about closely around the 'parent house'. Such a scatter, as well, provided an interespacing of open or unshaded parts for common use of all the partitioned units. Socially speaking, each of the households of such a group incorporates in its concept of a house the whole or nearly whole of the total residential arrangements. Even though property, income,and housing accommodation are separate for each household, there are obligations of kinship which keep families bound togethe as an effective micro-neighbourhood group within the total residential arrangement. The ways in which kinship operates as regards every detail of daily life and how far such a residential arrangement is particularly suitable to it requi to be studied. Generally speaking, the spatial arrangements in such instances are evolved mainly out of social needs, an the social group living under that arrangement finds that the spatial boundary, even if vaguely defined, contributes to its solidarity. The spatial arrangements may be one of irregular and close scatter of several households around a 'parent house', or one of lineal or circular dispersal or of extension of dwelling accommodation in any other geometric pattern. The pattern repeats or gets amplified, or an assortment of such patterns happen, with the increasing numb of households branching off in course of time and clinging t the 'parent house' as near as possible. The spatial limit of expansion of this is the caste sector beyond which encroachment is abhored. Even in the case of castes which did not have the joint family life the nuclear families

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followed the pattern of spatial structure outlined here. This shows the importance of maintaining a certain character in residential arrangements in a manner suitable to the importance of family and kinship in India. There is obvious need to make specific studies to ascertain the range of variations possible in such a character of housing. It is possible that by maintaining such a character of micro-neighbourhoods the social control value of the former neighbourhoods will not be lost and it will thus contribute toward better sources of residential satisfaction.

Against the background of this tradition for micro-neighbourhoods the residential choice of urban people tend to get explained. In my enquiry into the practice of subletting in a government housing colony in a metropolitan city I found the possibility of concluding that the urge to recapture the residential satisfaction provided by the traditional micro-neighbourhood motivated the practice of subletting. (Unni, 1962).

Spate's remarks (1958) in the context of a study of Asian urbanism in contrast to that of the West is here meaningful. He notes that both positively and negatively the principles of internal differentiation in Asian cities to a large extent run counter to accepted western norms, and that the planner must reckon carefully with this fact 'if his plastic surgery is not to be socially crude'. With reference to the housing of employees in Delhi based on income grades Spate is critical and he appraises that Delhi has shaped public housing programmes rather too fastly after the western model.

In the matter of housing in relation to community the recently developed planned towns in India offer an extensive field for study and assessment. D'Souza's study (1967) of Chandigarh exposes several dimensions worthy of the sociologist's attention in today's phase of developmen of planning and housing in India.

In the study of housing needs and wants the sociologist is probably the best qualified to make a balanced assessment of the character of needs. For, in India class and status factors not only influence locatio and other aspects of planned housing. Often, there is the projection of the standards of the professional and intellectual middle class into the programmes for rehousing of the working class. With the housing schemes ahead in the five year plans the importance of this sector of interest cannot be over estimated.

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How propinquity and homogeneity of the social group to be housed can affect neighbourly relations in the planned urban neighbourhoods is a problem of considerable scope for the sociologist to study with a view to modifying some of the favourite ideas about the effect of propinquity which the planner fosters. In the western countries studies in recent years have led to the revision of earlier findings on this and similar issues. The planner with his concern for a myria of factors in planning is either too busy to keep touch with the findings of research in other countries, or if he knows it, is not equipped to judge its applicability to the Indian context. In neighbourhood planning this issue is confronted at the very stage of site planning. The fact that site planning can affect social relationshi is an assumption based on the influence of physical propinquity, that is, people physically more close make frequent contacts. Another view is that homogeneity of social background in several important factors can make for group feeling and frequent interaction. Sharing of a variety of values and interests, of course, leads to friendship formation. Festinger (1951) for instance concludes that the decisions of the architect, planner o housing administrator will affect group membership and directly or indirectly the total context of the lives of the people. More recent thinking on the subject (Gans, 1963) shows that (a) propinquity can affect but not control the significant aspects of the matrix of soc life (b) "propinquity may be a necessary cause of friendship formation but homogeneity is the logically su cient cause"; and (c) propinquity need to be considered in site planning for it does play some part in controlli partially the functioning of social relationships. In the Indian context there are several factors of social differentiation entering to make propinquity to the point of being irrelevant to promote neighbourly relatio of a durable nature.

In the west, several of the favourite ideas of planners and architects are being exploded as myths unde the impact of research by sociological investigations. is time to make a beginning in India to learn the fixati of the technical professionals for certain ideas and assumptions and to similarly put them to the sociologica touchstone. For instance, it was in the past, and even among less informed professionals today, a rather stabilised belief that high density residential life may mean crimes of violence and crimes against some form of property for it is possible to find such a correlation. But as Chapman points out it is also possible to show th the lower the density of housing the greater the frequen of some other kinds of offences.

CRITICAL ISSUES IN FORMULATING HOUSING POLICIES IN INDIA

1. NEED FOR SUSTAINED POLICY DEVELOPMENT IN HOUSING

In India the shortages of housing are continually rising with the tremendous increase in population especially for the large economically weaker sections of the society. At the same time, the rate of growth of large urban centers has been phenomenal causing serious problems of breakdown of urban services, deterioration of human environment and quality of life. The problems of urbanisation due to migration for seeking employment, better facilities for living and other factors, are closely linked with policies on location of industries, creation of employment opportunities, and a choice between different living styles. In the next 20-25 years it is expected that the population of India would double thereby posing problems in terms of catering to a "Second India." One of the very critical problems is that of providing adequate human settlements at an economical cost considering the economical development of the country and poverty of increasingly larger number of people. Thus, the question of policies and physical wherewithal of human settlements, for the present and the potentially rising population, need to be examined in great depth using a composite integrated approach to the whole problem.

Housing needs to be examined not only in terms of rural, and urban setting but also as an instrument of social policy to achieve growth with social justice.

Further, it must be looked within the framework of land use policies and urbanisation that would provide a balance between rural, urban and regional development of a nature that could optimally utilise the resources. Housing needs to be considered as a part of human settlements and integrated with the activities of human beings in terms of work, education, health, communications, recreation, travel, etc. The quality and growth of housing and human settlements is a matter of public policy.

The problem of deteriorating living environment is further enhanced by the slow rate of economic development leading to paucity of resources. So far, the solutions have been highly inadequate and tackled in an ad hoc and piecemeal manner. This would require detailed considerations of all aspects relating to the overall problem. Housing may be considered as a cog in the spectrum of human settlements. The tremendous rate of urbanisation has created problems of inadequate services, and law and order problems in large metropolitan areas, while smaller towns are deteriorating because of a lower level of infrastructure. Further the rate

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of growth of metropolitan cities is much larger than those smaller towns because of the location of industries. The ne to interlink industry, transportation, land use(including housing) is of very much importance especially in thecontext the Energy Crisis. The situation is potentially explosive and is threatening to lead to a complete break-down of the hierarchy of the present pattern of urban settlements resulting in imbalances both within and outside resources-regions. Larger citiesare becoming larger and larger to the extent of becoming unmanageable with current technological, administrative and political practices, with the adverse quality of human life giving rise to great social consequenc and upheavals.

2. RESEARCH ON HOUSING POLICIES

1. The research would look at housing supply and demand in urban areas aswell as Rural areas with the object of proposing ways of upgrading current policies. Consideration of the priorities which the Housing Sector merits asan investment relating to other economic activities, and the use of housing policy in promoting employment and in stemming over-concentration of population in major urban areas will also be examined. Further, the research could be designed and coordinated to perm comparisons to be made among the different national policies. The contributions which can be made by governments, other public sector agencies (such as banks, LIC, social benefits of provident fund accou etc.), private enterprises, slumsand squatters' groups, housing cooperatives, private construction industry etc., will need to be assessed.

2. It is often felt that although massive housing proj have been undertaken in developing countries, ther remains a critical shortage of low-cost shelter fo the urban andrural poor who constitute a majority the population in developing countries. Thus, it necessary to critically assess the public policies on rural settlements, especially Housing, so as to reflect the social and economic realities in the country. Further, it should also attempt to measu the degree of opportunity which the poor people hav to obtain the housing in the conventional market.

3. Housing Policy will also need to be considered as a tool for achieving national objectives such as decentralising a country's population, or at least diverting the migrants away from the more densely populated areas into intermediate cities. This wou call for cooperation between sectors of industry, Agriculture, and Works and Housing agencies etc. The nature of these coordinations

that are necessary through suitable policy measures need to be spelled out so that the whole system is structurally balanc

4. In addition to individual country surveys involving demographi data, it is necessary to assess material, manpower and financi resources and methods of mobilising these for Housing vis-a-vi other sectors. Detailed consideration of the various innovations which are specifically designed to solve problems of low-cost housing such as provision of sits and services, the use of new materials and various levels of prafabrication of components; problems of administration and management of construction practices etc., will have to be undertaken. In formulating policies on Slums and Squatters' Settlements, government may be interested in preventing land speculation through registration of family holdings.

5. The International Development Research Centre at Ottawa, Canada, has initiated 3 research studies on low-cost shelter for(i) Asia (ii) Africa; and (iii) Latin America's Poor people; so that Science and Technology can be adapted to the specific needs of developing countries. The first study involved eight Asian countries, the final report of which is understood to be under preparation. However, the findings on comparative housing policies among participating countries have already spurred changes. For example, Thailand has adopted Singapore's approach in ending fragmentation in administration of its housing policies and setting up a National Housing Authority. Indonesia has just created an Urban Development Corporation to handle Housing and Urban Growth problems in an integrated manner.

6. Following the recommendation of the Ministers of State for Housing and Urban Development to set up a National Housing Commission, it is suggested that a national coordinated research study on housing policies, which could go into all these aspects, may be sponsored so that it could help realisti policy making in the country. In depth studies on socio-economic, technical aspects, organisation and infrastructure of construction industry, real estate development and management, urban land policy etc. may be sponsored to give a valid basis and framework for snythesis of these aspects in evolving a sound national policy.

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MEEDED RESEARCH STUDIES FOR FORMULATING HOUSING POLICIES DETAILS OF RESEARCH PROBLEMS

A series of investigations into aspects of urban and rural housing which need to be understood before formulating an enlarged public housing programme are required. Studies in the areas outlined here are either scanty or non existent. They are concerned essentially with the following broad areas of investigation:

Economics

(a) Whether a diversion of investment to housing would not in fact be beneficial to the economy from the point of view of raising the rate of savings, and raising levels of employment.

Social needs

(b) What kinds of accommodation (or essential amenities only) should be provided, how should loans be administered, and what special legislation if any is necessary to ensure continuing success?

Strategy of Housing

(c) Will the "incremental" housingprogrammes suggested here succeed in the face of quite possibly lower pricrities being attached by families - especially poorer families to housing than to other necessities of urban life? Will the fact of provision of improved housing lead to increased migration to these areas?

(d) The process of making effective and realistic Housing Policies and Programmes in terms of (1) Housing Situation - present & Future (2) Identification of problems (3) Strategies proposed (4) Planning and Design (5) Implementation Methodology (6) Administration and Management (7) Feedback, Monitoring and Evaluation, Information System. Specific case studies relevant to varying magnitudes of problems, resources and environmental conditions.

(e) What values of density, and what design parameters besides density should be adopted as quidelines in the broad layout and Planning of residential districts?

I: INVESTMENT IN HOUSING VIS-A-VIST OTHER SECTORS

It is often believed that from the national point of view housing is a "dead" investment, locking up resources which would be far better invested in industry or used in some other"productive" manner. The view is held to be valid regardless of the end product of the industry involved. Also, it is assumed that the investment in housing, from the point of view o economic development, is decidedly less desirable than investment in industry. But how far is this view correc It rests on the assumption that domestic savings are relatively inelastic, or if elastic are not related in any way to the availability of opportunities for investment in housing. Is it possible that if opportunities were offered to individuals to hirepurchase a house, this might result in a substantial increase in the rate of domestic savings? Would such payments towards the house encroach on other forms of savings, and if so how seriouslu? Or would there be a curtailment of consumer expenditure and a diversion of the savings so effected into housing? Since we are particularly concerned with the low income groups, it would be important to try to establish our findings especially in regard to these groups. How this can be done, forms part of the investigation. It seems difficult to do so because until now opportunities for savings towards a house have been practically non-existant for such groups. For somewhat higher income groups however, it may be possible to carry out both time-series and cross-sectional studies to test our hypothesis. The first may be possible with certain Housing Board occupan if we compare their pattern of savings before they were allotted a house with the pattern of savings after they were given possession of a house and started hire-purcha payments. Cross-sectional studies may be possible in companies by comparing the pattern of savings of those employees who have availed themselves of such opportunities with the pattern of those in a corresponding incor bracket who have not taken such loans. It may also be useful to take a look at information available from other countries(if possible, developing countries) although this may not be strictly relevant unless such countries are at a level of economic development that corresponds with that of India.

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II. LABOUR CONTENT IN HOUSING AS INDUSTRY

What is the labour content of the rupee spent on housing compared with the labour content of the rupee spe on other consumer product? The labour content will mean only the on-site labour content of housing, but the labou content of each of the inputs, such as aand, bricks, ston steel, lime, surkhi, asbestos cement, cement and so on. each of the manufactured items such as steel, cement, asb cement, flooring tiles, doors, windows etc. there is a further labour content, in addition to that contained in the value added by manufacture, and this is the labour content of the intermediate inputs materials, continuing backwards until we reach the stage of production of raw materials. It may be said that if we take into account a the backward linkages the entire rupee will be labour onl This may be true if we extend backward linkages through all previous items, and assume that labour is the only scarce primary factor, but in the immediate context we may suppose that the rupee will finally break up into several components including (a) labour, (b) taxes, (c) the cost of capital, including profits, (d) wholesale and retailer's margins which include some component of labour, which we may assess separately. There is also th rather special case of machinery. The production of machinery involves a labour component, and if we did add the contribution of each of the backward linkages, we can arrive at the final labour content of the machinery used producing any particular consumer product. As far as the labour content of the particular consumer product is concerned, machinery constitutes an intermediate input like any other and we must take as contributing to the consumer product the amount that the machinery depreciate over the production of a particular volume of consumer product and the labour content of this amount of deprecia

It would be important to express the labour cont of the rupee spent as described above not only in money terms of the component spent on wages, salaries and other benefits but also in man-hours of employment. The wage paid per manhour varies considerably from industry to industry. In a situation where we are trying to maximise employment in terms of numbers employed as well as in the amount that is paid to labour, the manhour figure for the rupee spent will be of some significance.

III. TAX COMPONENT ON BUILDING COMPONENT

What is the tax component in the cost to the consumer of various building materials and components. It may be that certain materials, but for the tax compone would be cheaper to use than others which are conventiona employed.

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What is the total tax component in a finished house, as compared with the tax content of various other consumer items? As with the labour content, this involves not only the tax on the last stage of production, but on all the intermediate inputs, extending the backward linkages up to the state of production of basic/raw materials.

IV: HOUSING SCHEMES - STRATEGY FOR LOANS AND ADMINISTRATION

Assuming that we find it desirable to encourage consumer spending on housing in preference to consumer spending on other items, what should be the rates of interest applicable to loans towards purchase of housing? The encouragement of investment in housing should be reflected in a longer repayment period and lowered rates of interest. On the other hand a rapid repayment of capital is desirable so that it is quickly recouped and made available again for recycling. Would it be possible to have differential rates of interest with lower rates for quick repayment of the loan and higher rates if the repayment of the loan is delayed?

How should loans for housing be administered, bearing in mind the need to reach as wide a market as possible, and particularly to reach the low income groups? It would seem that the best agency to perform the role of reaching the individual customer would be banks, rather than any centralised agency. The central agency may be responsibl for refinancing and insurance against bad debts. What steps would need to be taken in order to make it possible for banks to make available loans for housing over longer periods than the conventional 5 ot 10 years that banks normally allow? Would it be possible to link such bank loans for housing with deposit schemes or other forms for regular saving?

Particularly for the low-income groups, is it possible to have schemes by which payment towards housing is in kind rather than in cash? Perhaps certain jobs should be linked with the provision of a house, and wages paid partly in the form of coupons or a credit entry towards payment for the house. If such a scheme were developed, it should be made possible for a private employer also to avail of it for his employees. Alternatively, payment towards housing might be in the form of an acceptable kind of pice-work.

Whatever the schemes, if they are to work they will need to be supported by effective means for repossessio of the house in case of defaults in payment. Would special legislation be necessary to enable repossession? This is not an aspect of the problem that can be lightly regarded.

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Unless loan repayment can be reasonably assured.. We are unlikely in our economic circumstances to be able to sustai and progressively expand a major public housing programme.

Introduction of subsidy element as part of strategy and Management:

Can we introduce an element of cross-subsidy in the provision of housing, so that the lowest income groups pay less than actual costs for their housing, and the higher income groups pay more? Various formulae for cross-subsidy can be devised, all more or less arbitrary, but some condit that it seems important such a formula should satisfy are f that the total amount recovered by way of surcharges on the higher income group's houses approximately equal the total amount of subsidy offered to the lower income groups; secon that the amount of surcharge on any higher income group hou should not be so much that the final price exceeds the comp titive market price. It seems equitable, that the percenta subsidy or surcharge follow a graduated scale, those with t smallest accommodation qualifying for the largest percentag on-cost subsidy, and those with the largest accommodation paying the highest percentage surcharge. One danger to be guarded against with subsidies, is that accommodation is ma available below cost price, and consequently presumably bel market value. This implies some restriction on transfer of ownership of the subsidised accommodation, at least for a period of time, or some guarantee that the same low-income family is not able to claim a fresh house allotment after selling off an earlier one.

How would one ensure a sufficient volume of surcha to cover the subsidies desired? One way would be for publi housing agencies which are engaged in constructing low-inco housing to actively and simultaneously enter the middle and high income housing markets. This is an obvious way of tur what would otherwise be private developer's profits into earnings which can subsidize lower-income housing.

But for the public housing agencies to be seen constructing flats for the well-to-do may be politically unacceptable in view of the realities. The alternative of imposing a graduated surcharge varying with size of accommo of privately built housing may be possible, and the possibi should be examined, but one's first impression is that the difficulties of applying such a surcharge would be formidab Another possibility, less satisfactory because it leaves th really expensive housing untouched, may be to vary housing interest rates, charging higher rates for larger loan amoun against a single house collateral.

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V: CAPACITY TO PAY FOR HOUSING

There is considerable uncertainty concerning the "rent paying capacity" of various income groups in urban areas. Various attempts have been made to determine this figure by interviewing households, but it is by no means clear that the interviewing technique yields any reliable information on this point. There seems to be some evidence to indicate that the capacity to pay towards eventual ownersh of accommodation is higher than the so called "rent paying capacity", even of the lowest income groups, if they are assured ownership.

So far surveys and investigations seem to have been confined to obtaining answers to hypothetical questions such as "what kind of accommodation would you like?" and "How much would you be able to afford to pay for such accommodatio It is almost inevitably true that the costs of the desired accommodation, though the needs expressed are fairly modest, far exceed the individual's capacity to pay. This irreconcilable difference is lfet unresolved. Would it be possible instead to offer, first hypothetically, and then, in a real life situation accommodation over a range of sizes and amenit at an economic price which ensures a reasonable return or capital, and observe individual's preferences? This implies construction of accommodation, or the provision of amenities only, at levels well below those currently provided in public programmes, by using economic specifications for design life time lesser than the permanent type that is in vogue.

VI: ECONOMIC "MINIMUM" HOUSING STANDARDS - Functional and Technological Obsolescence:

Until quite recently, much of our approach to housin has been based on the assumption of a "minimum standard" of t rooms, independent bath, independent WC, and kitchen, in an a not less than 230 sq.ft. and using building materials which ensure a permanent type of construction with a life of someth like 80 years. This has not only been beyond the means of th income population to which it is supposedly addressed, but has also led to a level of investment which it is not possibl to sustain, and in consequence, the provision of housing has been a fraction of the demand. It has meant a steadily mount backlog and there has been no significant impact on the housi situation. For example, UN standards offer guidelines as to the lower-bound, in that the approximate cost of the house may be about two times the GNP per year. Although it may be about two times the GNP per year. Although it may be too low for developing countries, it indicates the need to experiment with different "minimum" standards. At the same time with a

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need to reduce disparities, it may be necessary to think of fixing "maximum" standards in different time-frames, in a su and effective manner(problem of implementation is also to be kept in mind).

If we are to make any such significant impact it is clear that we must develop schemes which are within the mear the households to which they are addressed. What we provide within these means may seem hopelessly inadequate, and we mu consequently make it possible for whatever is provided to be upgraded gradually to better standards as the economy develo and as people are able to invest more in their houses. This would mean developing the following:

(a) "Incremental" or "Flexible" Housing Planning:

Designs which make it possible to have minimum lev of investment to begin with, with gradual improvements over period of time so that the initial housing is steadily impro to a larger as well as a more permanent construction. This a design problem which has not yet been solved. It seems si enough to design a dwelling with the cheapest building mater such as bamboo matting or palm leaves, and to design another cost dwelling with brick walls and mud plaster and a tempora roof, and so on, up to a permanent type of construction with brick walls and a concrete slab. But the real difficulty is start with the cheapest form of construction and incremental upgrade it to the next better level, without distroying enti the initial construction and starting over again, and withou damaging seriously the livability of the house while constru is in hand. There is pbviously bound to be a certain amount of wastage involved in replacing one material with another, the design problem is to keep this wastage at a minimum.

(b) The materials and labour required for these increme improvements should be available on a domestic scale. In ot words the individual home-owner should be able to go to a re shop, invest a small amount of money at any point in time ar obtain a visible improvement in his accommodation, which enc him to repeat this kind of investment and gradually go on improving his dwelling.

(c) Ownership of the plot or a share in the plot, so th the householder has sufficient security of tenure to want to invest further and to improve his house. Transfer rights in such ownership, however, may need to be restricted in some w to protect the owners against "dadas" and to ensure that the essential purpose of such individual ownership is realised. This is especially important in slums, squatter colonies and other such "marginal/transitional" settlements.

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(d) Sites which are attractive for the prospective occupants. This means primarily, convenience of access, or access to a transportation system sufficiently moderately priced to be within the financial means of the occupants.

VII: ATTITUDES TO HOUSING IN DIFFERENT INCOME GROUPS

Is any programme of housing where we expect the householder to invest and make continuous improvements likely to succeed if individuals do not attach a high value to good housing? What are the family's attitudes to housing in different income groups? To what extent, in different income groups, do individuals regard their house as a place to sleep and keep their belongings, or as an object of pride and a measure of social status, or as an investment and security against the future?

VIII: CONSEQUENCES OF URBAN HOUSING VIS-A-VIS MIGRATION

Is it possible that the provision of improved housing in urban areas will lead to an increase in migration to these areas? To what extent is the lack of availability of reasonable accommodation in an urban area a disincentive to migration? It may be possible to answer the first question by an investigation of the second. In this connection it would be useful to examine whether there is any relationship between the amount of physical investme in any area and the extent of migration to that area For physical investment, it may be possible to use some indicator or a crude index, such as the amount of cement/brick/steel/wood consumed in that area.

IX. HOUSING DENSITY STANDARDS REALISTIC FOR INDIAN CONDITIONS

The standards of density (families per acre) which are adopted for most Indian cities in their current plans for development are derived from Western norms. According to these, for new developments densities of about 20 to 60 families per gross residential acre are recommended as being near the optimum. At the other extreme we have example of Housing, where new developments are being undertaken at planned densities of approximately 400 families per acre. It seems clear that infrastructure costs, such as the costs of water distribution, sewage collection, street lighting, power, telephones and so on vary inversely with the density of development. More correctly, the more compact a development for a given level of population, the lower the development costs. Apart from densities, this implies that the land uses which are high consumers of land, such as playgrounds, maidans, open areas, schools and hospitals are most economicall located on the periphery of any development, whereas the core which requires services is kept as compact as possible. A new area could be developed as a series of compact unclii, each varying in population size from 50,000 to 150,000 or more with the nuclii being linked together by a mass transportation system. Each nucleus will contain jobs, adequate local facilities for shopping, schooling, medical attention and so on, and residential accommodation for all income groups. The unclii will be discrete and distinct from each other, with open spaces between. What are the desirable densities to be adopted for each nucleus, considering costs and in particular transportation costs, and considering in particular transportation costs, and considering also the effects of density on the quality of the environment and the quality of special life?

Ground level or ground plus one, living is considered by many to be more human, more Indian and in some sense anti-big-city. In practice the lower densities that it implies may lead to a vast sprawl similar to what has happened in the case of New Delhi. Costs increase, particularly transport costs, (using the word "costs" in its broadest sense to include social costs as well as money costs). Does the lowered density result in a better quality of life than exists in some of the more densely packed areas of old Delhi? Or, is the optimum somewher in between? This investigation will be particularly difficult, because in comparing two different areas with different densiti there will be further differences in the qualities of amenities available in each area, differences in whether the area is newly settled or older with more well established social relationships, differences in the mix of income groups, occupyin each area, mixed land uses in a neighbourhood, and so on.

It may also be that densities of development which are satisfactory or desirable for one particular income group are not so for another. It is likely that with rising income, and a readier economic access to means of transport, there is a drop in the desired density level. Is this true for all income groups, or only the most affluent? Or are there cultural differences also for different parts of the country? We know that people in one part of the country prefer to huddle their houses together in a village even where there is otherwise plenty of space around and no danger from wild animal whereas in another part of the country they prefer to keep their houses spaced apart. Does this difference extend to towns?

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Are there any lessons to learn from the densities, number of storeys and layout patterns of the older pre-British Raj parts of Indian cities? How should such findings be used to develop guidelines for new work, given the fact that norms have changed, in such respects as for instance hygene and fire hazards, that aspirations are rising, that we have access to a different construction technology, and that with rising population the entire scale of the city has changed dramatically and inevitably?

X: DENSITY AND URBAN DEVELOPMENT - Evaluation of Relevance of Density as a criteria:

To what extent is density a meaningful criterion for measuring the quality of an urban development? It has the advantage of being easily measured, easily prescribed and easily controlled, at least in terms of the allowable extent of construction in an area, although the numbers of people occupying that construction are not so easily regulated. It also answers the need for a simplified global kind of index, whose single prescription would ensure the desired quality of urban development. The specifying of landuse whether an area shall be residential or industrial or commercial or for transportation and the stipulation of density of development are taken to be the two basic manipulable independent variables in the hands of the city planner. The correct mapping of the first, and the correct specification of the second for different areas of the map are generally taken to be sufficient to ensure a satisfactory urban development.

There can be no doubt that the extent of construction per unit of ground area is a good rough index of the openness or extent of crowding of buildings in an urban area. For instance Central London probably has 61,700 sq.ft.of construction per gross acre, Central Manhattan 302,000. Greater Bombay has 175,200 in Fort(South),42,500 in Bandra Hill.

For those who believe that the nature of the physical environment is a fundamental factor in determining the quality of city life, there can be no doubt that the regulation of density, and architectural design, are vital elements in establishing that quality. By and large the view is that the lower the density the happier the community although there is another point of view, particularly forcefully expressed by Jana Jacobs, which pleads for higher density levels and still more extreme view, not frequently encountered, which holds that a degree of crowding and tension in living is desirable to create the peculiarly "urban" quality in the environment which yields the creativeness and hynamism needed for progress.

The manner of resource conserving physical developments of rural and urban areas especially with the energy crisis, need to be evolved for varying conditions

XI. HOUSING AND PHYSICAL ENVIRONMENT

Assuming the view is valid that physical arrangement are of fundamental importance in establishing the quality of city, life, what, besides density, are the elements that matter? The height of a building? Trees? noise levels? traffic-free areas? Privacy? the opening of dwellings on community spaces? Ground floor living? variety in the physical environment? Variety in the range of a activities being carried out in the neighbourhood? the possibility of escape to open areas? convenient access to shopping and schools? Second, to the citizen living in an area, is it indeed the shape of the physical environment that is the most important factor in determining the quality of his lif Where, in the scale of relative importance, would one find the costs of transport? and consequently full cost of access to a variety of other areas? the quality of municipal servic opportunities for recreation? Opportunities for participat in community activities?

This will be a particularly complex and difficult investigation. Response will vary for different income groups. But what is especially difficult is that responden are probably unable to visualise correctly the possible alternatives, and unable to assess what their responses mig be in the alternative situation. The effect of physical arrangements in particular may also be subtle and indirect, and not immediately appreciated by the lay respondent. It is this very difficulty which makes it especially easy for the Planner, particularly one with an architectural backgro to assume responsibility for knowing best and to give weigh to matters of physical disposition, whereas to best satisfy citizens' needs it may well be more important to concentrat resources on other aspects of the development.

XII: METHODOLOGY FOR THESE STUDIES

Each of the investigations outlined above could be carried out in two phases. The first phase would be a desk study, involving a search for information which is of relevance to the particular investigation in hand, and an analysis of the available data. It would conclude with tentative findings and the formulation of case-studies and a field programme, if it is clearly evident that such a fie investigation is necessary. The second phase could be the field work and further analysis. These investigations woul be useful in evolving effective housing policies in new are regions or new towns. In existing cities a number of other related questions have to be investigated simultaneously.

The above questions have been investigated or given due consideration in the CIDCO new twin city complex in Bombay.

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